INSTRUCTION MANUAL

for

INSTRUCTION MANUAL
FOR
MICROWAVE SIGNAL GENERATOR
MODEL SG-13 AND SG-14

EMPIRE DEVICES, INC.
AMSTERDAM, NEW YORK

MP MASTER
MA36050

EMPIRE*

SINGER METRICS DIVISION

THE SINGER COMPANY
915 PEMBROKE STREET • BRIDGEPORT 8, CONNECTICUT

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INSTRUCTION MANUAL
FOR
MICROWAVE SIGNAL GENERATOR
MODEL SG-13 AND SG-14

EMPIRE DEVICES, INC.
AMSTERDAM, NEW YORK

WARRANTY

EACH NEW INSTRUMENT is warranted to original purchaser for one year from date of shipment against defects in material and workmanship. Electron tubes, semi-conductors, fuses and batteries are excluded from any liability. Any defective instrument will at our option be repaired or replaced free of charge, F.O.B. Factory.

If the purchaser experiences difficulty with the equipment, he shall notify the factory so that the manufacturer may instruct the purchaser, or repair the equipment on the purchaser's premises. If the defect cannot be cured in that way, the purchaser should then return the equipment prepaid to the factory at Amsterdam, New York. This warranty is void if the instrument has been tampered with or misused in any way, damaged by accident or negligence, or if the serial number has been removed or altered.

EMPIRE DEVICES, INC. • AMSTERDAM, N. Y.

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MICROVOLTS
PULSE WIDTH
FREQUENCY
CYCLES/SEC.
DELAY
FREQ. MULTIPLIER
SYNC. SELECTOR
DELAY MULTIPLIER
ATTENUATOR
POWER SET
ZERO SET
FM AMPLITUDE
MODULATION SELECTOR
KILOMEGACYCLES
7-11
POWER
2.5A
SLO-BLO
RF OUTPUT
MICROWAVE SIGNAL GENERATOR
MODEL SG-14
SERIAL NO
FREQUENCY RANGE
7-11 KMC
EMPIRE DEVICES INC.
AMSTERDAM, N.Y.

SECTION I

GENERAL DESCRIPTION

1.1 INTRODUCTION

Empire Devices' Model SG-13 and SG-14 Microwave Signal Generators are designed to provide RF signal voltages over the frequency ranges of 3800 mc to 7600 mc and 7000 mc to 11,000 mc respectively. The RF output frequency is indicated on a direct reading, counter-type dial. A minimum power output of 1.0 milliwatt is available over the entire frequency range. The output level is calibrated directly in DBM and microvolts. The signal generator provides CW, internal and external pulse modulation, linear frequency modulation and internal square wave modulation, as described below.

1.2 APPLICATIONS

Models SG-13 and SG-14 may be utilized as laboratory or field-type instruments wherever signal generators are required. Among the applications they may be used for are measurement of receiver selectivity, sensitivity, noise figure and spurious responses; determination of attenuation and VSWR; measurement of conversion gain; antenna gain and pattern analysis.

1.3 TECHNICAL CHARACTERISTICS

Frequency range:	SG-13 3800 mc to 7600 mc SG-14 7000 mc to 11,000 mc
Accuracy of frequency calibration:	± 0.5%
Frequency Stability:	
VS Temperature:	0.004%/°C
VS ± 10% Line Voltage:	0.01%
Output power:	1.0 mw, min.
Output range:	0 DBM to -127 DBM; 223,000 to 0.1 microvolts (calibrated directly in DBM and microvolts)
Attenuator accuracy:	SG-13 ± 2.0 DB (from -7 to -127 DBM) SG-14 ± 2.0 DB (from -7 to -127 DBM)
Output impedance:	50 ohms
VSWR:	SG-13 2:1 Maximum SG-14 2:1 Maximum
Power requirements:	115 volts ± 10%, 50 to 65 CPS, 275 VA or 230 volts ± 10% with re-connection.
Dimensions:	12 3/4" high x 17 5/16" wide x 14" deep
Weight:	68 lbs., including cabinet
Connectors:	RF output-type N female; all others type BNC female
Accessories furnished:	RF cable, 6 ft.

Tube and Diode Complement:	One 6080, one 6AU6, two 12AX7, two 0A2, one 6AQ5, six 12AT7, two 12AU7, one 6AS6, one 0B2, one 12BY7, one 7591, one 6236 klystron (SG-13 only), one 6390 klystron (SG-14 only), sixteen A-40, five SD-95, one 1N1786, one 1N488A, one 1N2358, four 1N459

Modulation Characteristics:

Output Synchronization Pulses:

Polarity -	positive, delayed and undelayed
Rate -	10 to 10,000 pulses per second
Amplitude -	15 volts peak, minimum
Rise time -	less than 0.2 microseconds

Internal Pulse Modulation:

Pulse Width -	0.3 to 10 microseconds
Repetition -	10 to 10,000 pulses per second
Delay -	2 to 2000 microseconds
Synchronization -	internal, external pulse, sine wave, or square wave

External Pulse Modulation:

Polarity -	positive or negative
Pulse width -	0.3 to 10,000 microseconds
Repetition rate -	10 to 75,000 pps
Amplitude -	20 to 70 volts peak

Internal FM Modulation:

Type -	modified linear sawtooth sweep
Frequency deviation, Max.-	$\pm$ 5 mc
Sweep rate -	10 to 10,000 cycles per second

External FM Modulation:

Frequency deviation, Max.-	$\pm$ 5 mc
Deviation -	continuously adjustable on front panel
Sweep rate -	sine wave response 10 CPS - 75 KC $\pm$ 1DB (FM amplitude control full on)

SECTION II

OPERATING INSTRUCTIONS

CAUTION

This instrument as shipped is wired for 115 volt operation. IF 230 volt operation is desired, re-connections must be made as outlined in paragraph 4.3 of the MAINTENANCE AND REPAIR SECTION.

2.1 GENERAL

To operate the Model SG-13 or SG-14, the RF controls should first be adjusted, then the modulation controls should be set to obtain the desired output signal as outlined in the following paragraphs. Figure 2-1 may be used as an aid. With the instrument plugged into the proper power source, turn the power switch on and allow a warm-up period of 5 minutes. Connect the RF cable from the RF output connector to the unit under test.

2.2 CONTROL AND CONNECTOR DESCRIPTION

CONTROL OR CONNECTOR	LOCATION (FIG. 2-1)	FUNCTION
Power Switch	A	The instrument is energized when the switch is turned to the "ON" position and the line cord is connected to a power source.
POWER Indicator	B	Glows when the instrument is energized.
Fuse	C	Primary line voltage fuse. 3.0 AMP SLO-BLO for 115V 1.5 AMP SLO-BLO for 230V
RF OUTPUT Connector	D	RF output of the instrument appears here.
DELAYED SYNC Connector	E	Provides a positive pulse simultaneous with the leading edge of the RF pulse when MODULATION SELECTOR (Q) is in the INT PULSE position.
UNDELAYED SYNC Connector	F	Provides a positive pulse preceding that at the DELAYED SYNC connector by a time determined by the DELAY MICROSECONDS (V) and DELAY MULTIPLIER (W) controls.
SYNC IN Connector	G	Input for synchronizing signals.

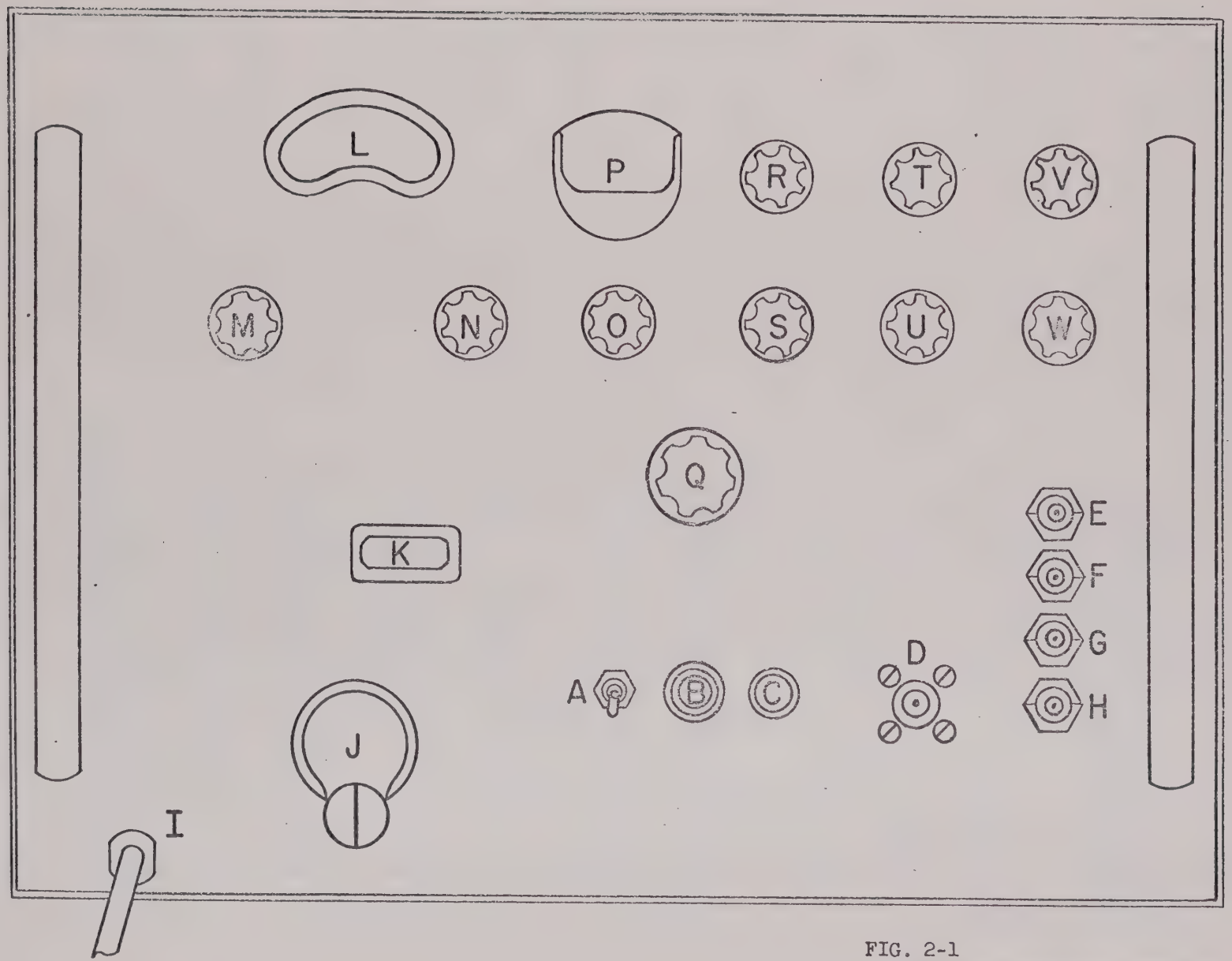


FIG. 2-1
CONTROL AND CONNECTOR LOCATION

CONTROL OR CONNECTOR	LOCATION (FIG. 2-1)	FUNCTION
EXT. MOD. Connector	H	Accepts inputs for direct amplitude or frequency modulation of the instrument depending on the position of the MODULATION SELECTOR (Q).
Power Cord	I	Connects the instrument to a power source.
Tuning Crank	J	Turns the frequency KILOMEGACYCLES dial (K).
KILOMEGACYCLES	K	Indicates the RF output frequency.
- DBM MICROVOLTS	L	The dial, read in conjunction with the cursor indicates the RF output power.
ATTENUATOR	M	Adjusts the level of RF output.
POWER SET	N	Adjusts the amount of RF power fed to the power monitor reference bridge.
ZERO SET	O	Balances the power monitor reference bridge in the absence of signal.
Power Monitor Meter	P	The power reference indicator for calibrating the output level.
MODULATION SELECTOR	Q	Selects the type of modulation to be applied to the oscillator.
PULSE WIDTH	R	Sets the width of the RF pulse when the MODULATION SELECTOR (Q) is in the INT PULSE position.
FM AMPLITUDE	S	Adjusts the frequency deviation of the RF oscillator for either internal or external modulating signals.
FREQUENCY	T	Sets fine frequency of the internal repetition rate generator.
FREQUENCY SYNC SELECTOR	U	Sets coarse frequency of the internal repetition rate generator or selects the type of external synchronizing signal to be applied to the SYNC IN jack.

CONTROL OR CONNECTOR	LOCATION (FIG. 2-1)	FUNCTION
DELAY	V	Fine adjustment of the delay between pulses appearing at the UNDELAYED SYNC and DELAYED SYNC jacks.
DELAY MULTIPLIER	W	Coarse adjustment of the delay between pulses appearing at the UNDELAYED SYNC and DELAYED SYNC jacks.

2.3 POWER OUTPUT CALIBRATION

(A) Turn the tuning crank to obtain the desired frequency as indicated on the digital display KILC MEGACYCLES dial.
(B) Turn the MODULATION SELECTOR switch to OFF and adjust the ZERO SET control for a Zero Set indication on the power set meter.
(C) Turn the MODULATION SELECTOR switch to CW and adjust the POWER SET control until the needle on the power set meter is over the Power Set line.
(D) Adjust the ATTENUATOR control to the desired output level as indicated on the DBM/Microvolts Dial.
(E) Once these adjustments are made, peak power for square wave or pulse modulation is ± 1 DB of CW power.

2.4 MODULATING THE OUTPUT

If a known level of RF signal is required, first adjust the instrument as outlined in Section 2.3 above.

2.4.1 CW Operation - For CW operation, simply leave the MODULATION SELECTOR switch in the CW position.

2.4.2 Internal Square Wave Modulation -
(A) Turn the MODULATION SELECTOR switch to Sq. Wave.
(B) Set the FREQ. MULTIPLIER/SYNC. SELECTOR switch to X1, X10 or X100 and adjust the FREQUENCY Cycles/Sec. control for the desired repetition rate.

2.4.3 Internal Pulse Modulation -
(A) Turn the MODULATION SELECTOR switch to Int. Pulse.
(B) Set the PULSE WIDTH Microseconds control to the desired pulse width.
(C) Set the FREQ. MULTIPLIER/SYNC. SELECTOR switch to X1, X10 or X100 for internal synchronization, or to ~, - or + if external synchronization is desired. The external synchronizing signal is fed into the SYNC IN connector. The polarity of the synchronizing input pulses must correspond to the setting of the FREQ. MULTIPLIER/SYNC. SELECTOR switch.

(D) Set the DELAY MULTIPLIER switch and DELAY Microseconds control as desired, not to exceed the amount shown in Figure 2-2.

(E) The UNDELAYED SYNC. connector provides a positive pulse, simultaneously with the sync. in signal or at the chosen internal repetition rate.

(F) The positive pulse appearing at the DELAYED SYNC. connector is coincident with the leading edge of the RF output signal and is delayed from the signal at the UNDELAYED SYNC. connector by the amount shown on the delay control.

2.4.4 External Pulse Modulation

(A) Turn the MODULATION SELECTOR switch to Ext. Pulse, either [illegible] as determined by the polarity of the incoming pulse.

(B) Apply the external pulse signal into the EXT. MOD. connector. The pulse width may be from 0.3 to 10,000 microseconds [illegible] with an amplitude of from 20 to 70 volts peak. The repetition rate may be from 10 to 75,000 pps.

2.4.5 Internal FM Modulation

(A) Turn the [illegible] MODULATION SELECTOR switch to Int. FM.

(B) Set the [illegible] MODULATION SELECTOR switch and FREQUENCY [illegible] for the desired sweep rate.

(C) Adjust the FM AMPLITUDE control for the desired deviation.

(D) Synchronization for an oscilloscope can be obtained from the UNDELAYED SYNC. jack.

2.4.6 External FM Modulation

(A) Turn the MODULATION SELECTOR switch to Ext. FM.

(B) Connect the modulating signal to the EXT. MOD. connector.

(C) Adjust the FM AMPLITUDE control to obtain the desired deviation.

(D) Set the FREQ. MULTIPLIER/SYNC SELECTOR switch to ∿, + or -.

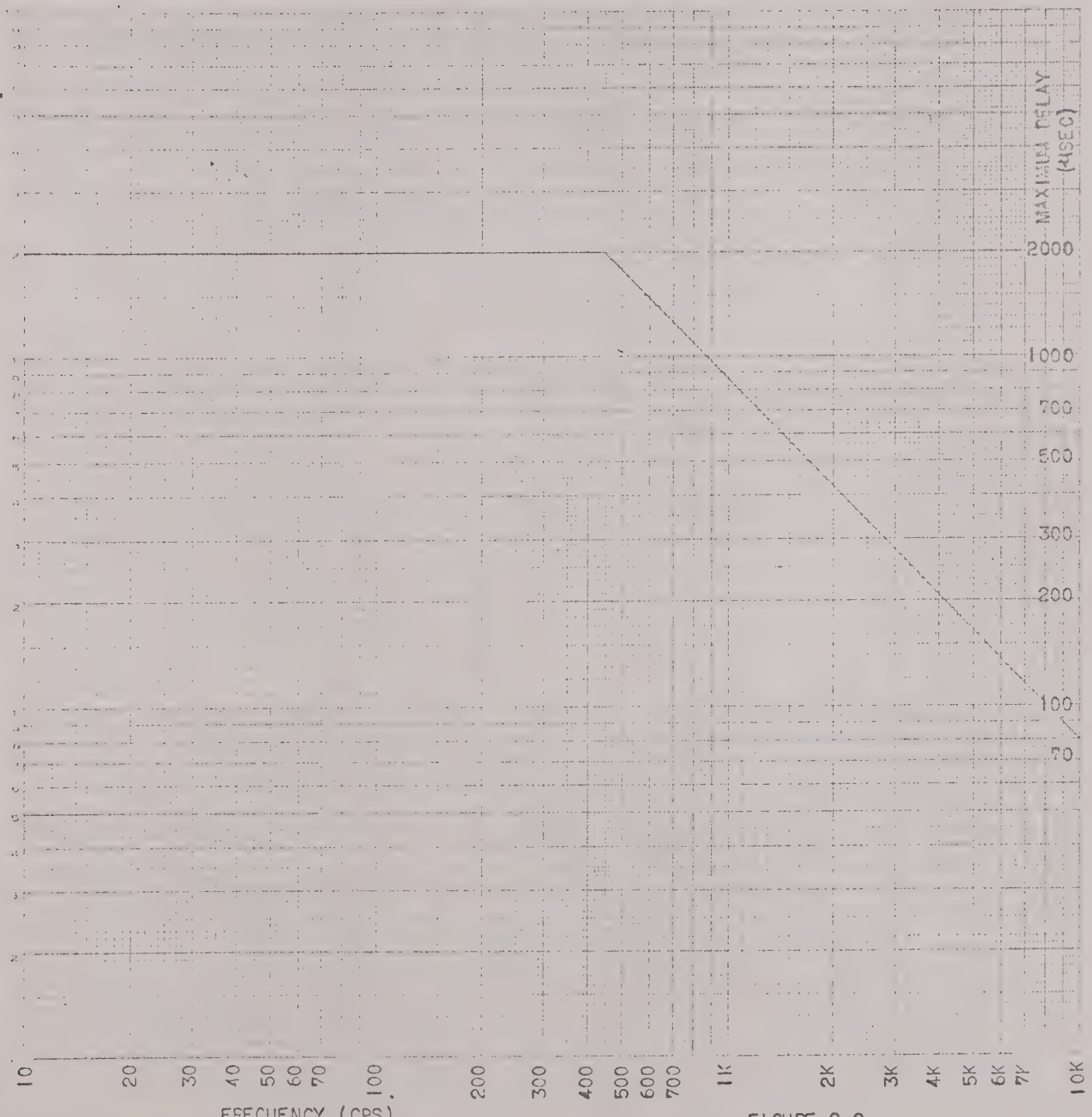


FIGURE 2-2
MAXIMUM DELAY VS: FREQUENCY

SECTION III

THEORY OF OPERATION

3.1 GENERAL

The SG-13 and SG-14 Signal Generators contain external cavity reflex klystron oscillators, attenuators, a power monitoring circuit, power supplies, and circuitry capable of supplying a wide variety of modulating signals to the klystron.

3.2 POWER SUPPLY

Refer to Fig. 3-1 for a block diagram of the Power Supply.

3.2.1 Repeller Supply -1510V- Repeller voltage for the klystron is supplied by a conventional, series passer type, 510V regulated supply. V104 is the passer tube, V105 the amplifier, and V106 the reference. The output of this supply is "stacked" on the -1000V supply thus appearing as -1510V to ground.

3.2.2 -325V Supply - The -325V supply is a conventional, series passer type, regulated supply. It obtains its reference voltage from V103. V101 is the passer tube and V102 the amplifier. It supplies power to the modulator and power monitor bridge.

3.2.3 -430V Supply - Bias for five stages of the modulator is supplied by the reference tube, V103. It is regulated but not settable as its voltage is dependent upon the nominal voltage of V106 plus that of the -325V supply it is "stacked" upon.

3.2.4 Keyer Supply - This is an unregulated nominally 170V supply stacked on the -1000V supply. It supplies plate voltage for the klystron keyer tube, V210. Part of its output is regulated by a breakdown diode CR410 to supply bias to the klystron.

3.2.5 Beam Supply(-1000V) - The beam voltage for the klystron is furnished by this supply. V401 is the passer tube and V402 the amplifier. Reference voltage for the supply is furnished by the -325V supply. A time delay relay S401 delays the application of line voltage to the primary of the Beam Supply and Keyer Supply transformer T401.

3.3 MODULATOR-KEYER

Refer to Fig. 3-2 for a general block diagram of the modulator-keyer. Specific functions are described below.

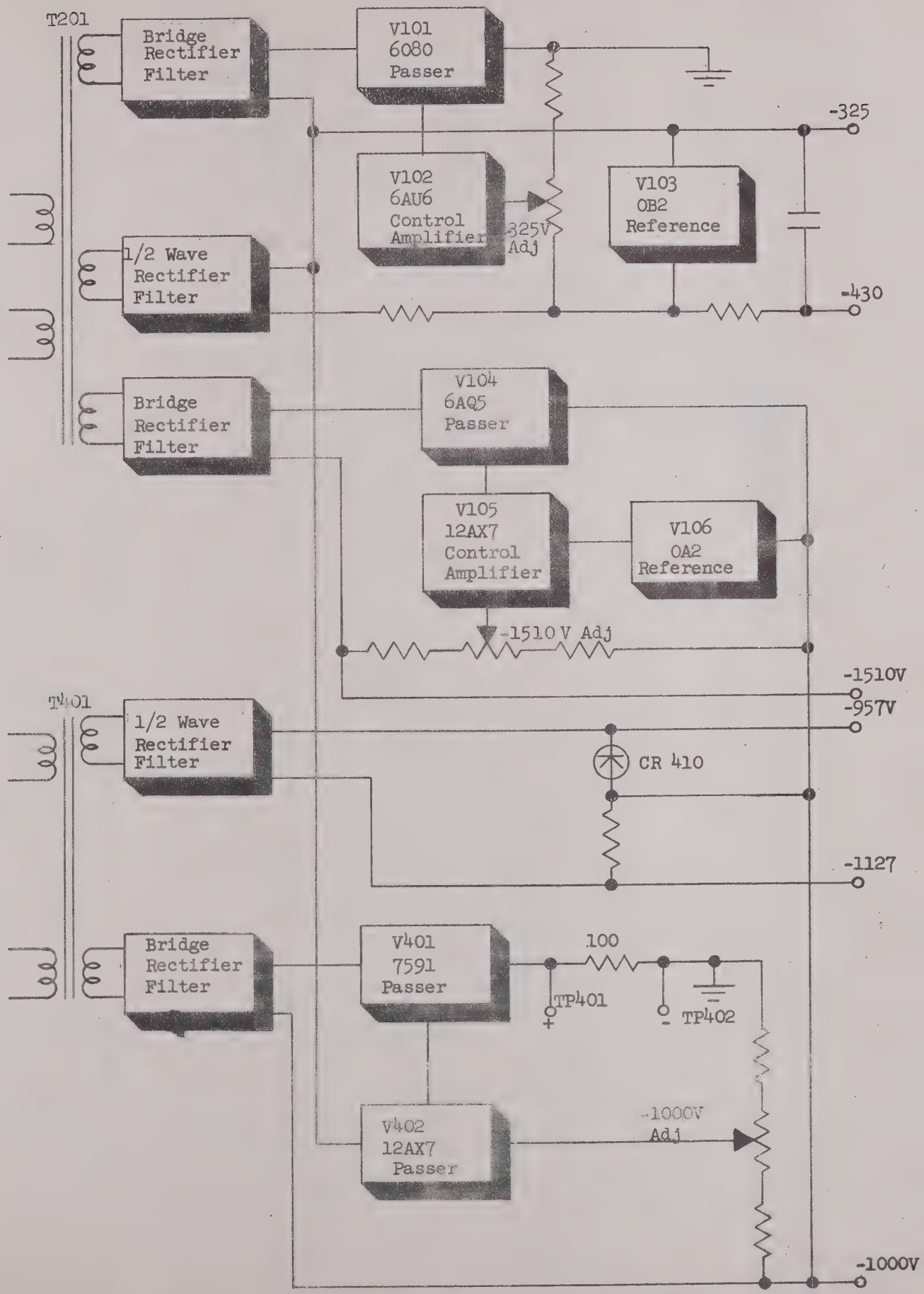


Figure 3-1
POWER SUPPLY

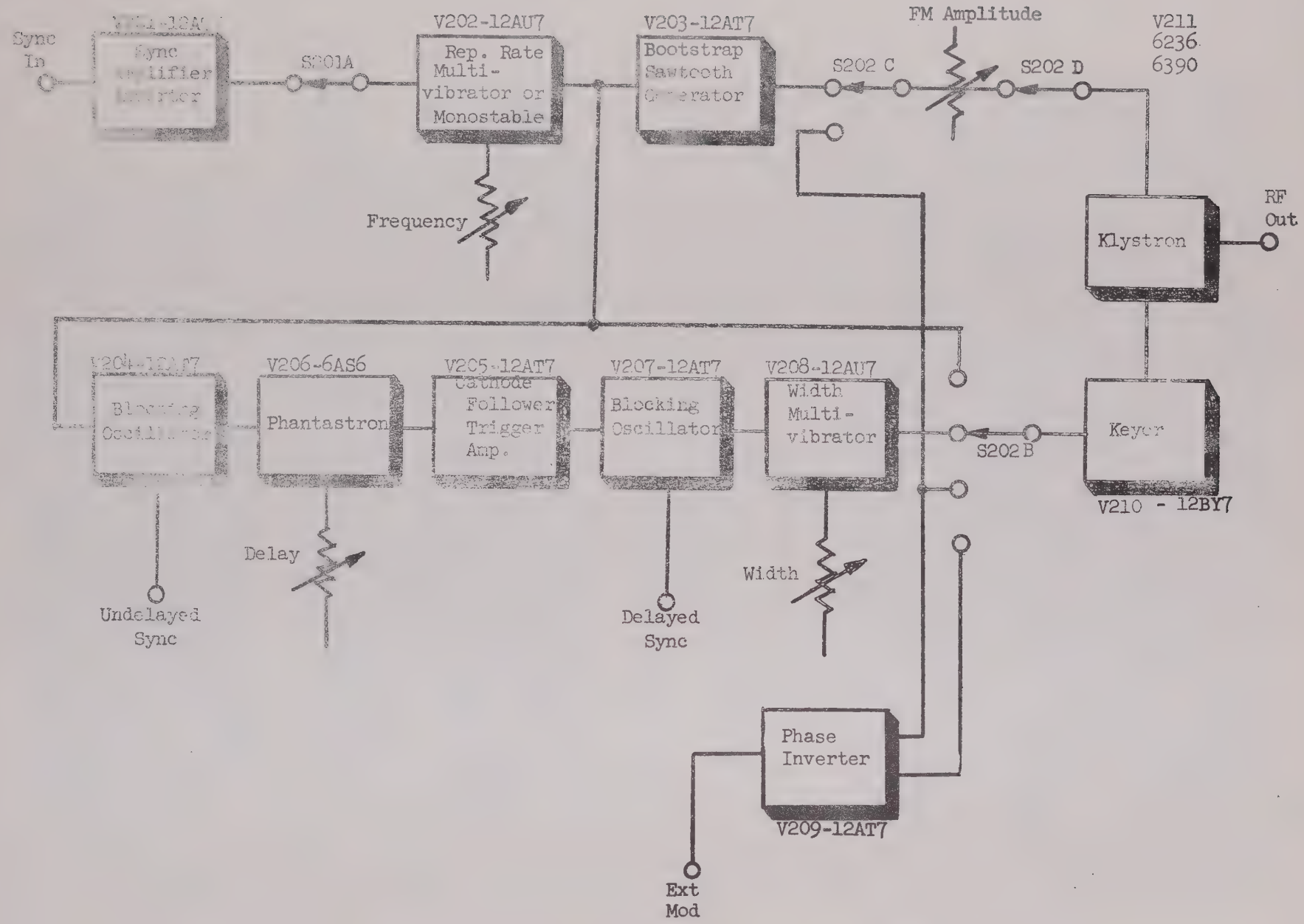


Figure 3-2
MODULATOR-KEYER

3.3.1 Klystron and Keyer - The klystron used in the SG-13 and SG-14 signal generators has a modulating grid which permits beam current to flow when it is positive with respect to the cathode. In order to turn the klystron on and off in response to modulating signals in a practical manner, a keyer tube, V210, is used. V210 is direct-coupled to the klystron grid so that when it conducts, the klystron grid is made negative with respect to its cathode, beam current does not flow and there is no RF output. When V210 is cut off, klystron grid voltage is determined by a voltage divider consisting of V210's plate load (R287 and R288), and R311 (or R312), the KLYSTRON BIAS adjustment pots. This voltage divider is supplied a regulated voltage by CR410.

V210's grid is returned to S202 B where signal and fixed bias voltages are selected for the various modes of operation.

The klystron's repeller is coupled through a capacitor to S202d. S202d bypasses the repeller to the cathode for all functions other than FM for low incidental FM modulation. In the Ext FM and Int FM positions, S202d connects the repeller coupling capacitor to the FM AMPLITUDE pot, then through S202c to the desired FM modulating signal.

3.3.2 Modulator - Modulator operation may be best understood by reference to Fig. 3-3.

OFF (Fig. 3-3a) - The grid of V210 is biased so that V210 conducts heavily and the klystron is turned off.

CW (Fig. 3-3b) - The grid of V210 is biased beyond cutoff, turning on the klystron.

SQUARE WAVE (Fig. 3-3c) - With S201 in the X1, X10 or X100 positions, V202 generates a large amplitude square wave which is coupled to V210 by S202A-B. Conduction of V210's grid clamps the square wave, permitting it to be driven far beyond cutoff on negative peaks. Therefore, the klystron grid is driven alternately between the voltages corresponding to the OFF and CW functions and the RF output is a square wave whose peak power is equal to the average power had the switch been in the CW position.

INTERNAL PULSE (Fig. 3-3d) - The generation of an RF pulse whose width and delay are adjustable internally and whose repetition rate may be set either internally or obtained from an external source is accomplished by this function.

(a) EXTERNAL SYNC -

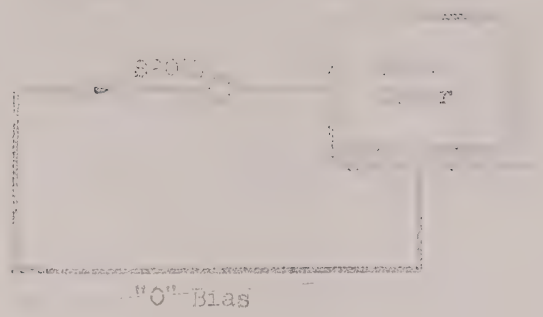
When an external repetition rate generator is used, its output is fed into the SYNC IN jack. V201a amplifies, limits and inverts the applied signal. If a positive pulse, or a sine wave or square wave is applied, it is further limited and re-inverted by V201b.

S201a selects the output of either V201a or V201b when it is in the - or + and ~ positions respectively. The waveforms selected by S201a are coupled to the grid of V202a, half of a monostable multivibrator, which provides a standard output pulse, triggering the UNDELAYED SYNC. blocking oscillator, V204.

(3b)

Figure 3-3

Page 1 of 3



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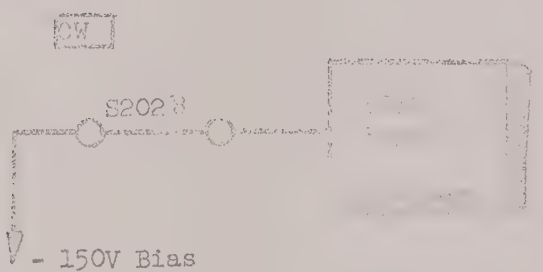

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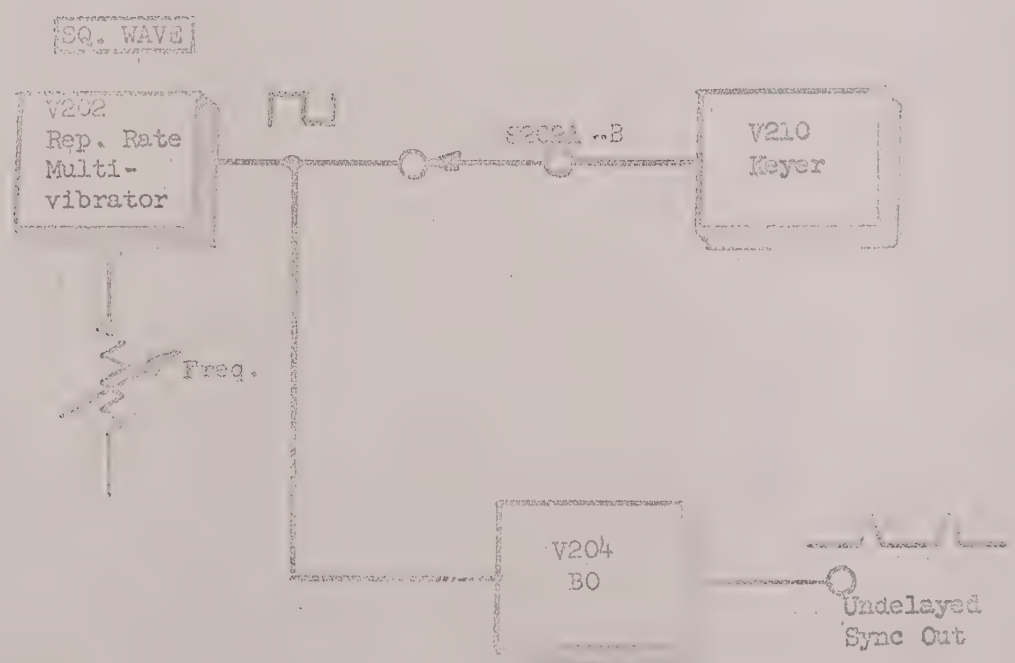


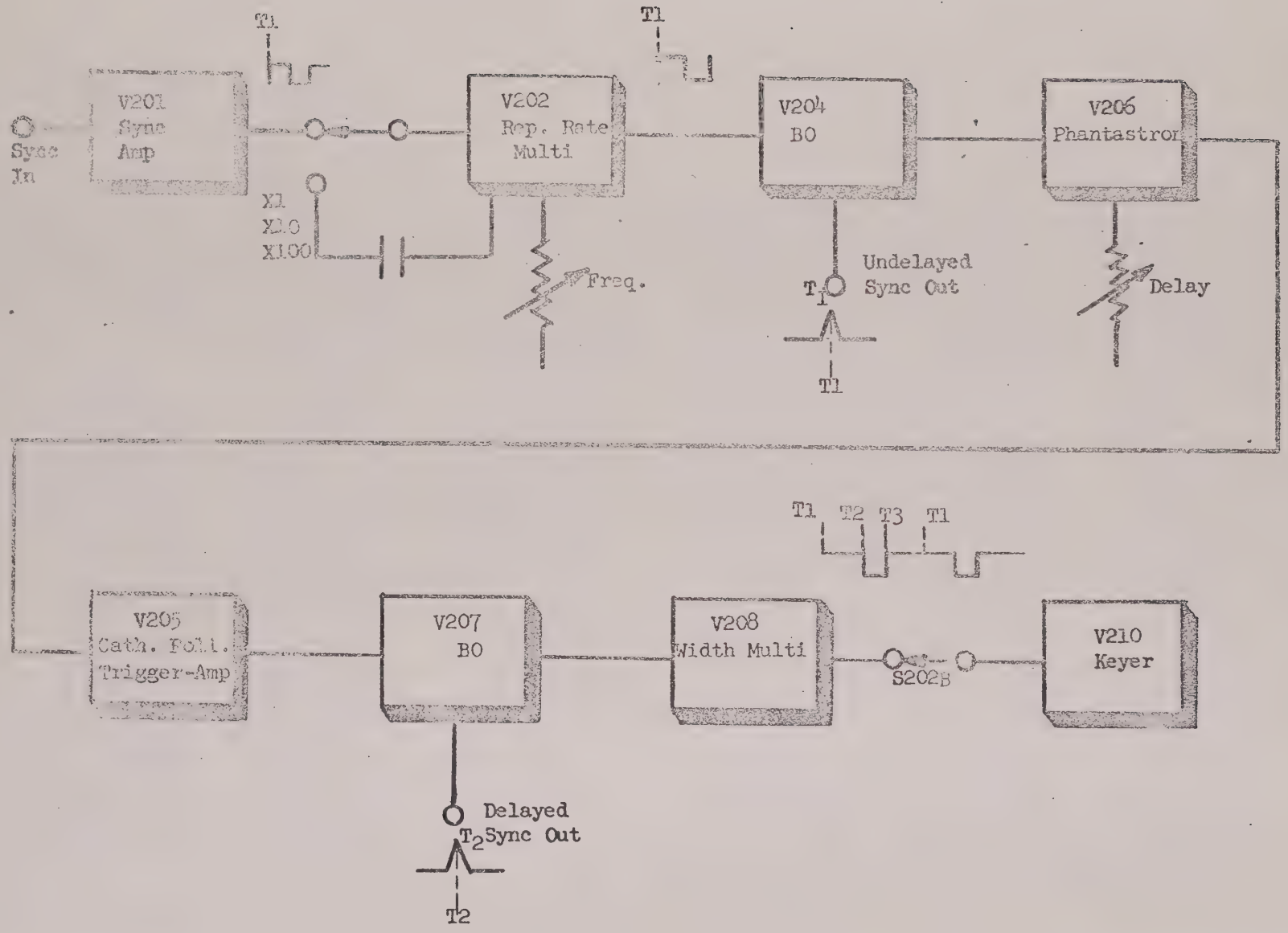


Figure 3-3
MODULATION - KEYER OPERATION
Page 2 of 3

(b) INTERNAL SYNC

When the repetition rate is to be generated internally, S201 is set to the X1, X10 or X100 position, converting V202 into an astable multivibrator. The square wave appearing at the plate of V202b is differentiated and used to trigger V204, the UNDELAYED SYNC blocking oscillator.

(c) DELAY

V204 provides both a positive pulse at the UNDELAYED SYNC jack (J205) to synchronize external equipment and a negative pulse to trigger the phantastron, V205a and V206.

V205b amplifies the gate generated by the phantastron. The amplified gate is differentiated and the positive spikes used to trigger V207.

V207, the DELAYED SYNC blocking oscillator provides a positive output at the DELAYED SYNC jack, (J206) and a negative output to trigger V208. There is therefore a precision delay between the UNDELAYED SYNC output and the DELAYED SYNC output, equal in length to the phantastron's gate. Obviously the maximum delay cannot be longer than the period of the modulating signal and due to the recovery time of the phantastron, must be shorter.

(d) PULSE WIDTH

V208 is a monostable multivibrator. It is triggered by V207 and the width of its output pulse is set by R264 and R265. The negative pulse output is selected by S202b and applied to V210, cutting it off for the duration of the pulse. The klystron will therefore produce no RF output until the grid of V210 is driven to cutoff and a peak power output equal to the CW output while it is cut off.

EXTERNAL +, EXTERNAL - (Fig. 3-3e) - Pulses of either polarity applied to the external modulation jack are coupled to the grids of V209, a split load phase inverter. When positive pulses are applied they are coupled from V209's plate through S202a-b to V210's grid. Negative pulses are coupled from the cathode of V209. In either case, V210 and the klystron operate as previously described in the INTERNAL PULSE section.

INTERNAL FM (Fig. 3-3f) - V202 operates as a square wave generator and is coupled to V203a's grid where it is clamped. The time constant in V203a's plate circuit in conjunction with V203b, the feedback cathode follower, produces a linear ramp output during the time V203a's grid is negative and no output while it is positive. The cathode of V203b is coupled to the klystron's repeller through S202d, the FM AMPLITUDE pot, and S202c.

V210 is biased off as in CW operation.

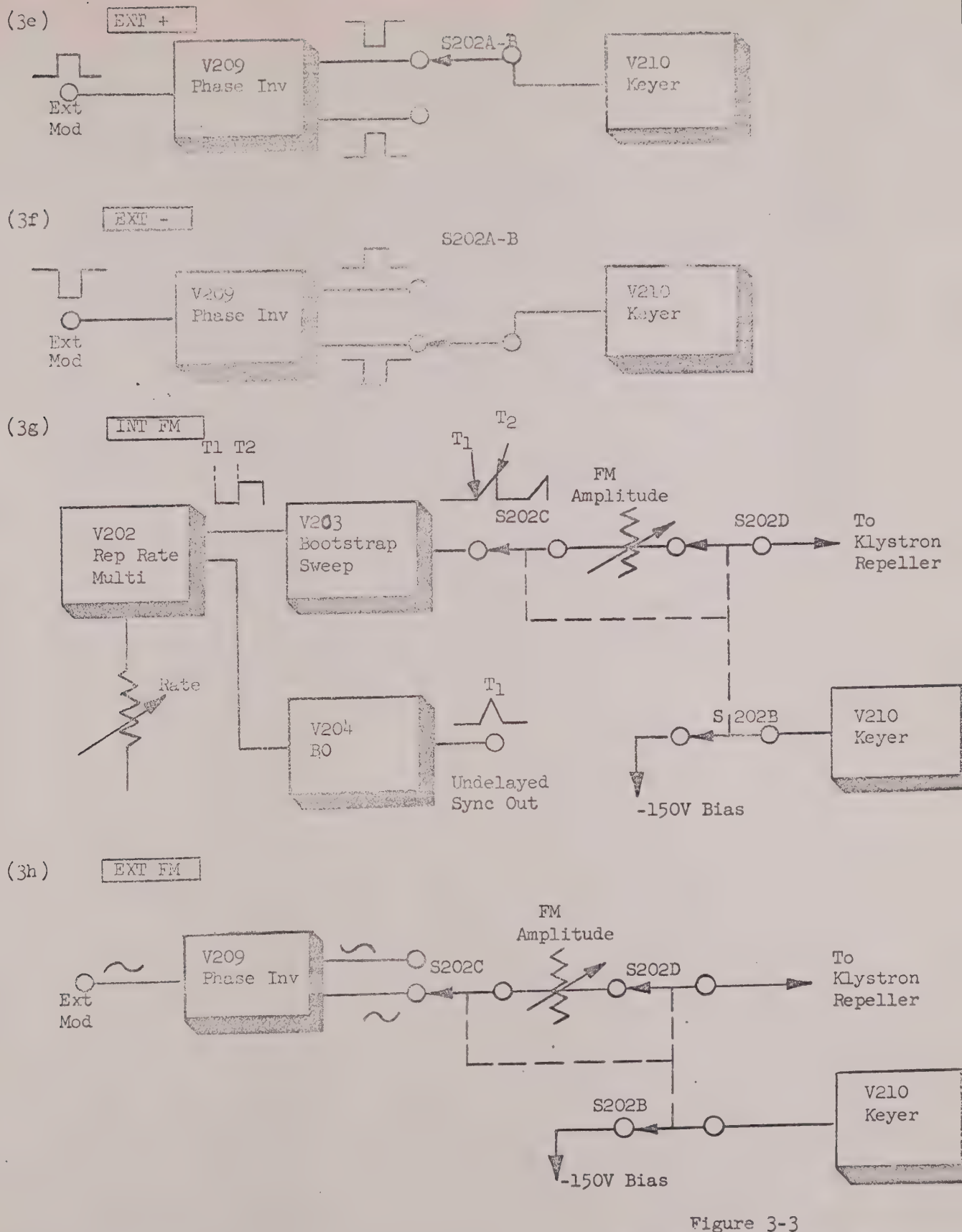


Figure 3-3
MODULATOR KEYER OPERATION
Page 3 of 3

3.4 POWER MONITOR

The power monitor circuit is a bridge circuit consisting of a dual bead thermistor assembly RT203 in one arm and precision fixed resistors in the other arms. The bead thermistor assembly is located in a machined block attached to the left-hand gusset. A coaxial cable carries RF energy to the block from a waveguide-below-cutoff attenuator probe which samples RF energy in the klystron cavity. This attenuator probe is mechanically connected to the POWER SET control and the cursor of the -DBM, MICROVOLTS dial.

In operation, the klystron is turned off and the ZERO SET control adjusted for the current required to balance the bridge. When the klystron is turned on, RF power heats the bead thermistor, changing its resistance, causing unbalance in the bridge. This unbalance is indicated on the meter M201. Another identical attenuator probe couples power to the front panel RF OUTPUT connector J208 and is mechanically connected to the ATTENUATOR control and the -DBM, MICROVOLTS dial. Since the probes are driven identically, adjusting the POWER SET control to deflect the meter to the power set mark (with the MODULATION SELECTOR switch on CW) will result in the power output indicated by the cursor.

Two disc thermistors (RT201 and RT202) are thermally coupled to the bead thermistor. They compensate the bridge for changes in ambient temperature. RT201 varies the current through the bridge to maintain the resistance of the bead thermistor constant. RT202 varies the sensitivity of the meter.

V212 further regulates the -325V supply for stable operation of the power monitor.

SECTION IV

MAINTENANCE AND REPAIR

4.1 GENERAL

The SG-13 and SG-14 Signal Generators are composed of four interconnected sections. Facing the front of the instrument the left hand gusset contains the beam and keyer power supplies and the repeller voltage limit potentiometers; the right hand gusset contains the remainder of the power supplies; the horizontal chassis and front panel comprise the modulation signal generating circuitry; the klystron keyer, the klystron cavity and its drive mechanism are located at the bottom of the instrument.

Maintenance consists chiefly of replacing aging tubes and the consequent recalibration of front panel controls.

In all cases of malfunction it should first be determined that the power supplies are operating correctly since many circuits are critical as to applied voltage.

In the event of malfunction, reference to Figures 3-1, 3-2, 3-3, and 4-3 will enable the localization of the trouble.

4.2 CASE REMOVAL

To remove the case, place the signal generator face down on a smooth surface. Remove the 4 screws from the rear and lift the case off vertically.

4.3 LINE VOLTAGE CONNECTION

SG-13 and SG-14 Signal Generators are shipped with the proper connections and fuse for 115V 50-65 cps operation. Figure 4-1 illustrates the reconnection for 230V 50-65 cps.

When the instrument is used on 230V, a 1.5A SLO-BLO fuse should be installed in the front panel fuse holder. For 115V operation a 3AMP SLO-BLO fuse should be used.

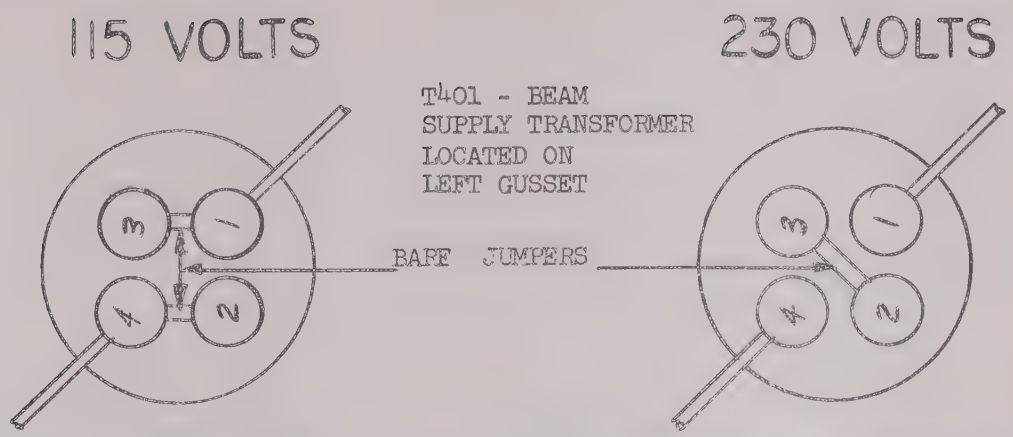
4.4 PREVENTATIVE MAINTENANCE

Following the procedures outlined below will greatly prolong the instrument's life and reduce the probability of breakdown.

4.4.1 Lubrication - The klystron drive mechanism should be lubricated every 1000 hours of operation with SAE #30 oil as indicated in Figure 4-2. Do not use more oil than called for.

4.4.2 Electrical Adjustment - Every 1000 hours of operation the power supply voltages should be checked as outlined in Section 4.5.1. Regulated supplies should measure within 1% of the indicated values for 115V $\pm$ 10% line voltage. If a resetting of the controls does not enable proper operation, tube replacement is indicated.

At this time, a recheck of the modulator control calibration and klystron beam current as outlined in Section 4.5.2 and 4.5.3 is advisable.



NOTE: WHEN CHANGING TO 230V OPERATION RECONNECT BOTH TRANSFORMERS AND CHANGE THE FRONT PANEL FUSE TO 1½ AMP SLO-BLO.

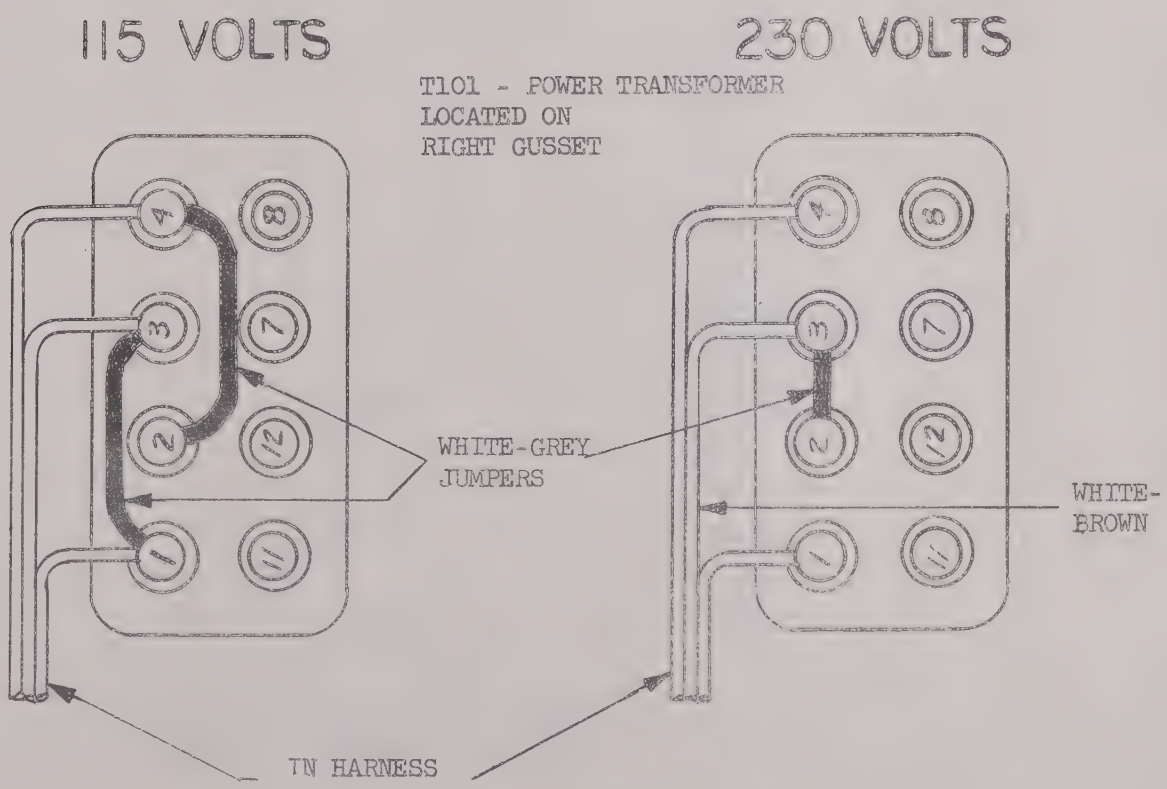
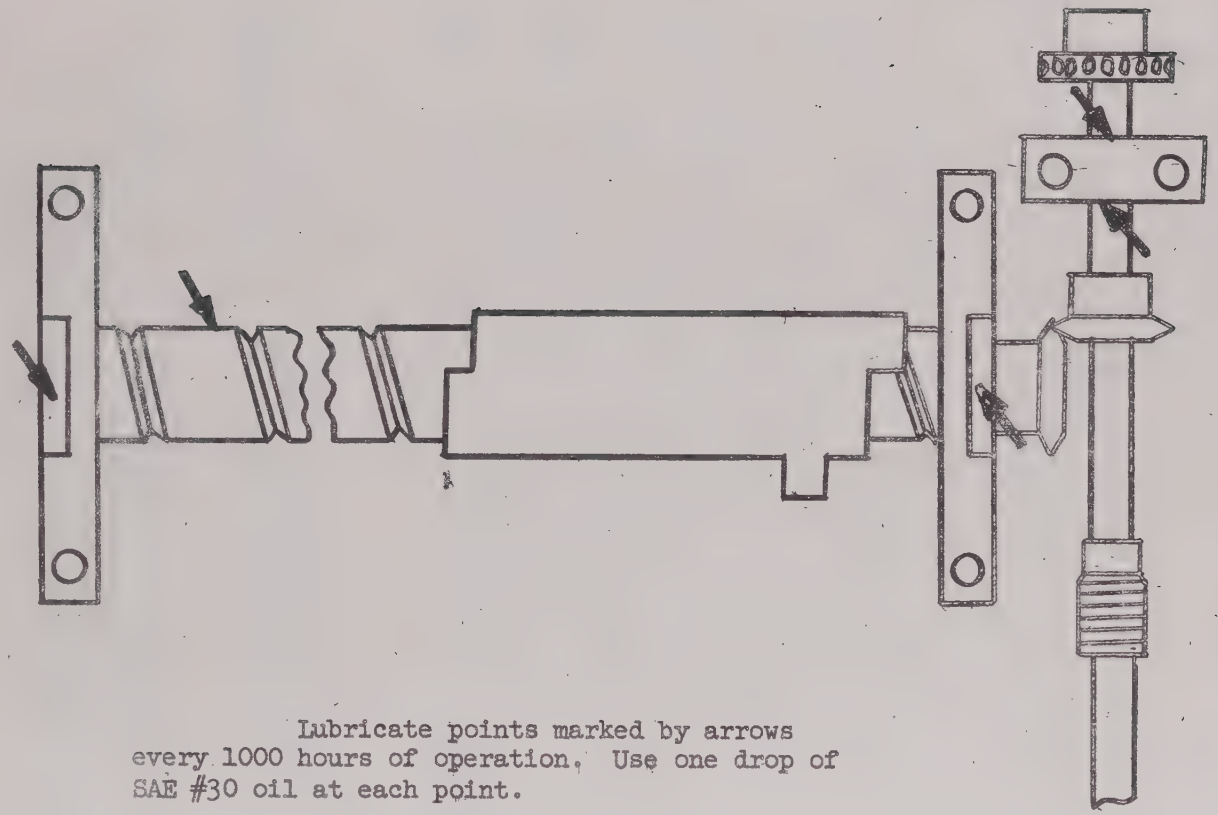


FIGURE 4-1
LINE VOLTAGE CONNECTION



Lubricate points marked by arrows every 1000 hours of operation. Use one drop of SAE #30 oil at each point.

Figure 4-2

LUBRICATION

4.4.3 Air Filter Cleaning - To insure long component life it is essential that the fan air filter be kept clean. Due to the extreme variance in dust conditions at different sites it is impossible to prescribe a definite timetable for air filter cleaning. The filter should be cleaned with soap and water whenever a thin layer of dust is apparent on its outside surface. After cleaning a light coating of machine oil or one of the proprietary filter coating products will greatly increase its efficiency.

The filter is removed by taking off the four screws at the corners of the filter shroud. The rack mounted instrument has its filter mounted internally necessitating the removal of the dust cover before removing the shroud.

4.5 CALIBRATION AND ADJUSTMENT

If improper outputs are being obtained from the SG-13 or SG-14 control recalibration may be required. When the necessary adjustment falls outside the range of the potentiometers, tube or component failure is indicated. In all cases, the power supplies must be operating properly before adjustment of modulator or klystron controls.

4.5.1 Power Supplies - Power supply voltages are accessable at the barrier strip (TB201) illustrated in Figure 4-3 located on the modulator chassis. Voltage setting pots are located on the two end gussets. Plug the power cord into a variable source set to 115V ± 1% and allow at least five minutes for warm-up.

The -1510 supply is adjusted first by adjusting R132 -1510 for 510V DC ± 1% between terminals 5 and 6 of TB201. Reset the line voltage to 105V and 127V to test regulation. The regulation should be better than 1% and regulation due to any combination of front panel control setting should be considerably better.

After setting and checking -1510V supply, connect a voltmeter between terminal 3 of TB201 and ground and set the -325V supply by adjusting R116 to 325V ± 1%. Test the regulation the same way the -1510V supply was checked.

The -1000V supply is adjusted with R411 -1000V. This voltage may be read between ground and terminal 6 of the barrier strip TB201. Test its regulation the same way the -1510V supply was checked.

4.5.2 Modulator - The modulator controls may be calibrated in any order, provided that during calibration the delay control setting never exceeds the maximum allowed for the repetition rate used per Figure 2-2.

Frequency - The frequency of the rep. rate multivibrator is determined by precision components. To shift all ranges in the same direction, loosen the set screws on the FREQUENCY knob and slip it until the best registration occurs. Frequency may be indicated by connecting a frequency counter to the UNDELAYED SYNC jack.

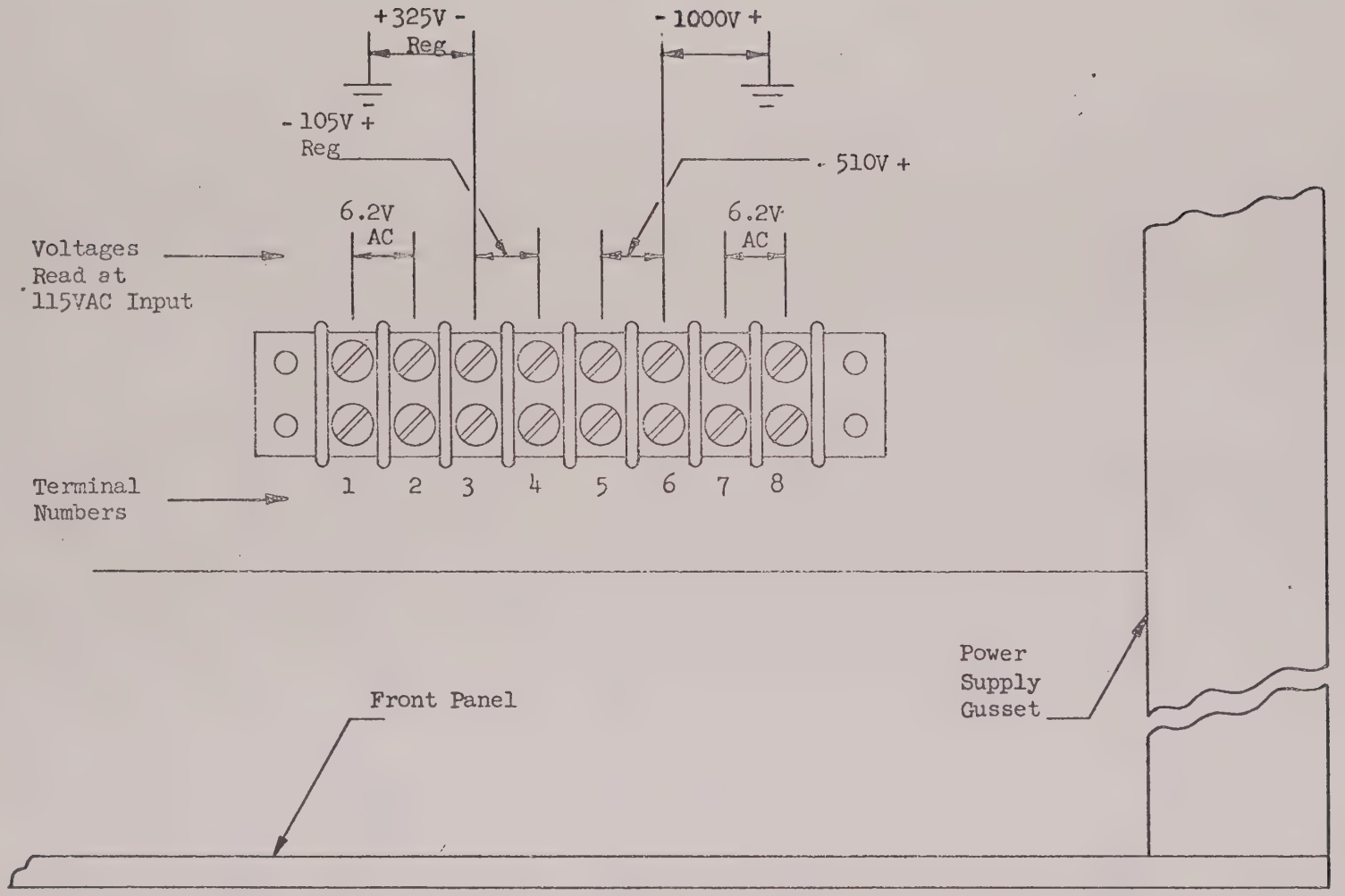


Figure 4-3
TB201
POWER SUPPLY
INTERCONNECTION

Delay - The coincidence of the delay ranges is brought about by the use of precision components. Shifting of all ranges simultaneously is accomplished by adjusting R237 and R236, the MIN DELAY and MAX DELAY pots. The knob on R235, the DELAY pot, is set so that the indicator points to "2" when the knob is rotated to the counter-clockwise stop. When adjusting the delay, set the FREQUENCY below 300 cps. Delay may be observed by triggering an oscilloscope from the UNDELAYED SYNC output and observing the displacement of the detected RF output pulse from the beginning of the sweep. Alternately, an EPUT meter may be used, obtaining its start trigger from the UNDELAYED SYNC output and the stop trigger from the leading edge of the detected RF output pulse.

Width - Adjust the signal generator for internal pulse operation with 2 usec DELAY, 1000 cps FREQUENCY, and a 10 usec width. Connect a detector with a low load resistance to the RF OUTPUT connector. Observe the detected signal on an oscilloscope by synchronizing the scope's trace with the DELAYED SYNC output pulse. Crank the RF frequency control throughout its range and note the variance in the starting time delay. Select a frequency of medium delay and adjust the PULSE WIDTH ADJ pot R265 for a 10 usec width as indicated on the oscilloscope and the WIDTH control. Vary the WIDTH control to check its markings against the pulsed RF output. If they do not agree, slip the knob and re-adjust R265 for best coincidence.

Zero Adjust - Turn the MODULATION selector to OFF. Turn the ZERO SET control to the center of its mechanical range. Adjust R279, the METER ZERO control until the meter needle is over the zero set mark.

4.5.3 Keyer - The SG-13 keyer contains two controls and the SG-14 one control to set the klystron "on" current. If the klystron does not turn off completely, a defective keyer tube V210 or component in V210's circuitry is indicated.

Klystron current is read by connecting a voltmeter of at least 20,000 ohms per volt sensitivity between TP401 and TP402. A 100 ohm resistor in the klystron cathode circuit is connected between TP401 and TP402. Voltage developed across this resistor is proportional to klystron beam current.

4.5.4 Klystron Removal and Replacement - To remove the reflex klystron tube from the resonant cavity, proceed as follows, using Figure 4-4 as a guide.

a. Loosen the clamp which secures the tube shield to the cavity housing.
b. Remove the tube shield by pulling gently straight out. If the socket does not come off with the shield, pull it gently straight back also.

NOTE: Never apply side motion or pressure to the klystron tube since this tube is very fragile.

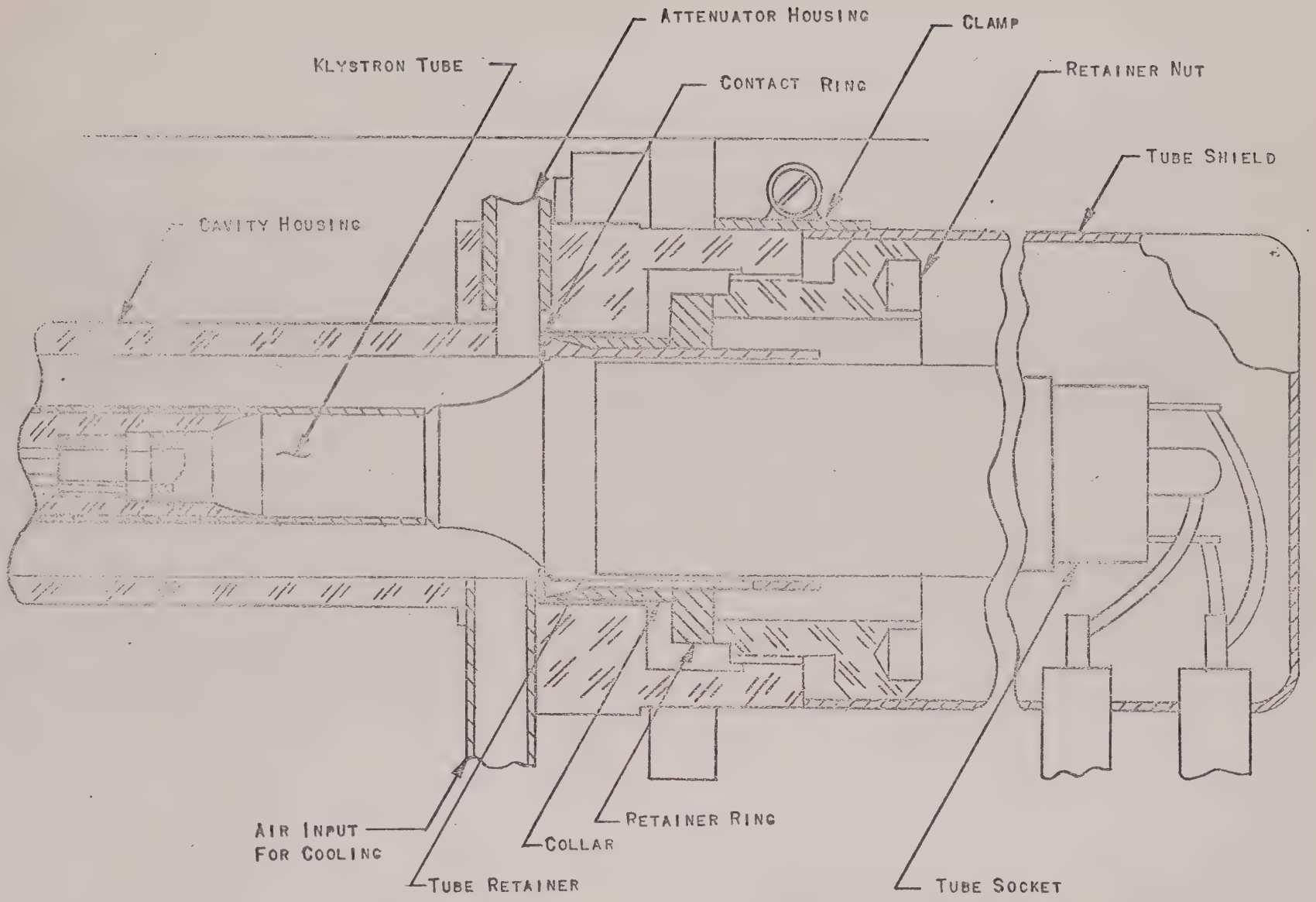


FIGURE 4-4
KLYSTRON OSCILLATOR

c. Using a spanner wrench, loosen and remove the tube retainer nut.

d. Grasp the tube firmly and pull it straight out. The retainer ring, collar, and tube retainer will come out with the tube. The contact ring (a dimpled washer) will remain in the cavity.

e. Remove the contact ring from the cavity. If the ring looks too flat, it may be rejuvenated by sandwiching it between #80 J grit emery cloth and two cold rolled steel blocks and applying 15 tons of pressure.

f. To replace the klystron tube, first loosen the center conductor clamping screw (on the end of the cavity opposite the socket) and pull the center conductor out approximately one inch. Second, place contact ring into cavity. Third, assemble the tube retainer and the collar onto the klystron tube (see Fig. 4-4). Fourth, push the tube axially into the cavity until it seats.

g. Place in the retainer ring and then the retainer nut and tighten with spanner wrench to 30 ± 5 [illegible].

h. Replace the socket, being careful not to apply any side pressure to the tube.

i. Replace the shield and clamp. Tighten the clamp.

j. Push the center conductor gently back into the cavity until it seats. Tighten its clamping screw.
NOTE: The klystron must be tracked per paragraph 4.5.5 when the tube is replaced.

4.5.5 Klystron Frequency Tracking - When the power supply voltages are reset or the klystron replaced, retracking will be necessary. Tracking consists of mechanical adjustments to cause the cavity's resonant frequency to agree with the counter dial and electrical adjustments to optimize repeller voltage.

Adjust the controls for CW operation.

Connect an RF power meter or a crystal detector and DC meter to a wavemeter covering the frequency range of the signal generator. Connect the wavemeter to the RF output jack and adjust the ATTENUATOR control for as low a reading on the indicator as is practicable.

SG-13

(a) Check to see that the microswitch is actuated at 4.35 KMC ± 50 MC.

(b) Connect a voltmeter of at least 20,000 ohms per volt sensitivity between TP401 and TP402. Crank the frequency lower than that at which the switch clicks. Adjust R311 KLYSTRON BIAS - LF for 0.8V between the test points.

(c) Crank the frequency KILOMEGACYCLES dial to any frequency higher than that at which the switch clicks. Adjust R312 KLYSTRON BIAS - HF for 1.4V between the test points.

(d) Crank the frequency KILOMEGACYCLES dial to 07.60. Adjust R300 7.6 KMC to obtain maximum output. Measure the frequency with the wavemeter. If there is difficulty in obtaining an output at this or other frequencies refer to Figure 4-7 for proper repeller voltages and preset them to those values.

(e) Crank the frequency KILOMEGACYCLES dial to [illegible] and adjust R299 4.4 KMC for maximum output.

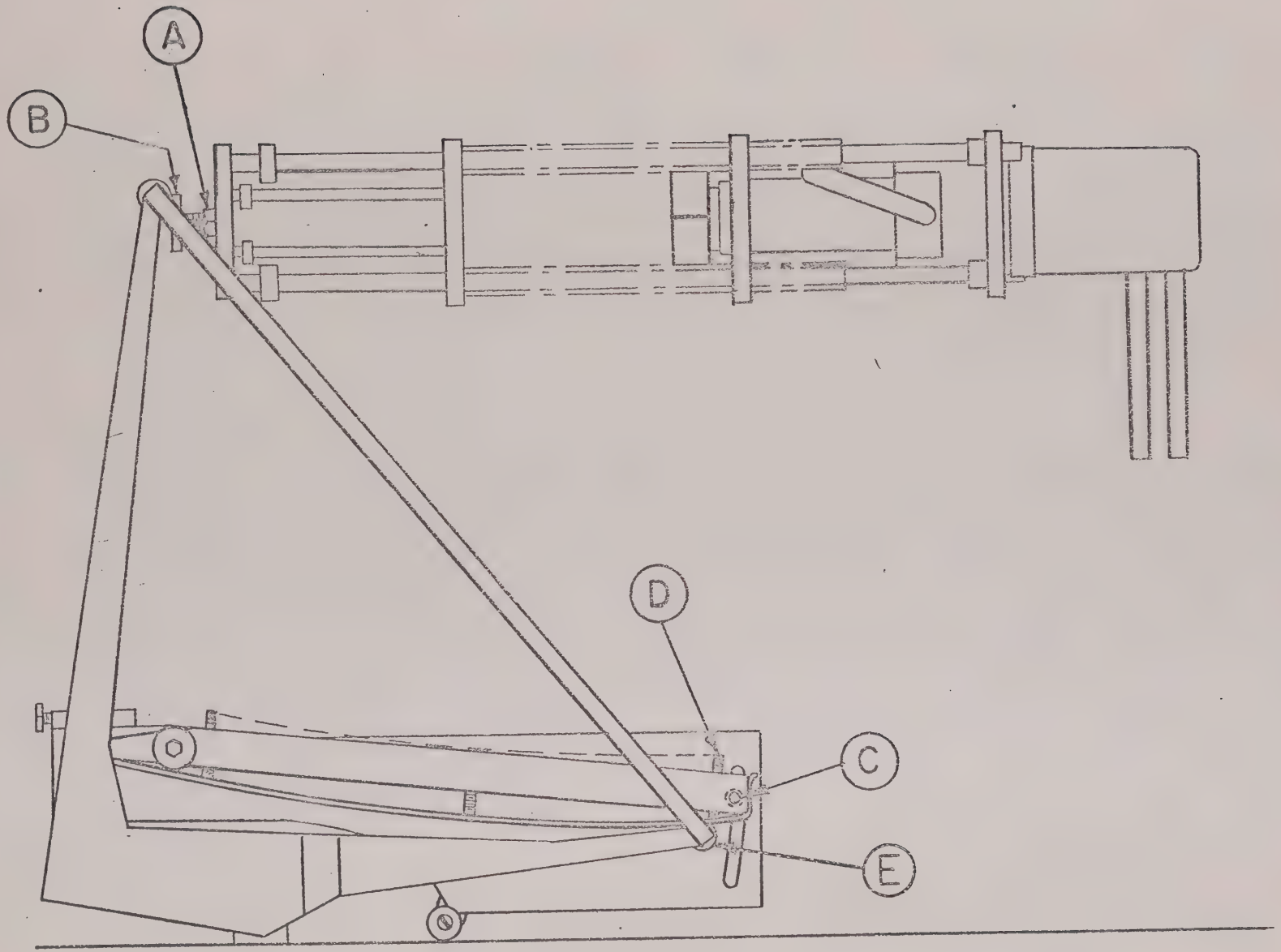


Figure 4-5
KLYSTRON TRACKING

(f) Crank the frequency KILOMEGACYCLES dial to 03.80. Adjust R303 3.8 KMC to obtain maximum output. Measure the frequency with the wavemeter.

(g) Repeat steps (d) and (e). If the frequencies measured are within 0.5%, accuracy is sufficient. Check a few random frequencies in between. If the intermediate frequencies are within 0.5%, proceed to step (k). If the dial accuracy is not sufficient, proceed with the mechanical tracking described in steps (h) through (k) and refer to Figure 4.5.

(h) Crank the KILOMEGACYCLES dial to 03.80. Loosen locknut "A" and alternatley adjust screw "B" and repeak R303 3.8 KMC until the wavemeter indicates a 3.8 KMC output.

(i) Crank the KILOMEGACYCLES dial to 07.60. Repeak R300 7.6 KMC. If this frequency and others in the middle of the generators' range are now within tolerance, alignment is complete.
If not, loosen "C", the ramp clamping screw and alternately adjust the ramp angle and peak R300 7.6 KMC until the wavemeter indicates 7.6 KMC output. Repeat step (h) if necessary. Once again check intermediate frequencies and if they are not within tolerance proceed to step (j).

(j) Back off one turn, all but the two end cam setscrews "D". Starting at the high frequency end turn the crank until the roller bearing "E" on the cam follower is tangent to the race at the point where the first cam setscrew "D" touches the race. Adjust that screw until the frequency indicated by the frequency meter agrees with that on the KILOMEGACYCLES dial. Adjust each succeeding screw in the same manner.

(k) Adjust the generator for pulse operation as described in Section 2.4. Connect a crystal detector with a low load resistance and an oscilloscope to the RF OUTPUT JACK. Synchronize the oscilloscope with the pulse from the DELAYED SYNC. jack and adjust the WIDTH control for 10 usec. Observe the detected pulse and crank the generator throughout the entire frequency range. Adjust R300 7.6 KMC, R299 4.4 KMC, and R303 3.8 KMC for maximum pulse output with minimum overshoot and jitter at their respective portions of the range as shown in the chart, Figure 4-7.
It may also be necessary to adjust R311 and R312 Klystron bias pots.
CAUTION: Do not adjust pots to produce more than 2.0 volts across test points TP401 and TP402.
If proper pulsing is still not obtained loosen the klystron retainer nut and slightly rotate the klystron in the cavity using care not to exert side pressure on the tube. If the generator can not be made to supply a clean pulse over the entire frequency range, it may be necessary tc replace the klystron tube.

SG-14

Tracking of the SG-14 is similar to that of the SG-13 outlined above with the exception of frequency range, switching of repeller modes, and klystron bias setting.

(a) With the instrument turned off, connect an ohmmeter between the common terminal of the microswitch and the slider of the tracking pot (white dot). As the crank is turned, the ohmmeter reading will decrease to zero and then increase again and the microswitch will "click" (once on either side of the zero resistance point as the crank is turned back and forth). If necessary loosen the microswitch and slide it so that it "clicks" symmetrically within one digit of the KILOMEGACYCLES dial on either side of the zero resistance point.

(b) Turn on signal generator and set to CW position. After 15 minutes warm up adjust R311 KLYSTRON BIAS for 2.0 volts + 10% between test points.

(c) Crank the KILOMEGACYCLES dial to 11.00 and adjust R300 11.0 KMC for maximum output.
Crank the KILOMEGACYCLES dial to 07.00 and adjust R303 7.0 KMC for maximum output.

(d) Crank the KILOMEGACYCLES dial toward the high frequency end. At approximately 9.2 KMC a "click" caused by the microswitch will be heard. Crank to just beyond this point and adjust R307 9.3 KMC for maximum output. Crank the KILOMEGACYCLES dial toward the low frequency end. Just beyond the place where the microswitch again "clicks", adjust R306 9.1 KMC for maximum output.

(e) Repeat steps (c) and (d) until no improvement is noted. If the dial frequency is within 0.5% tracking is complete. If the accuracy is insufficient, track the generator as described in steps (h) through (k) in the SG-13 tracking procedure except that 7.0 KMC should be substituted for 3.8 KMC and 11.0 KMC substituted for 7.6 KMC wherever they appear in the instructions. In addition R306 9.1 KMC is used to peak the output just below the mode switching point and R307 9.3 KMC peaks the output just above. If two peaks or an abrupt change in output is noted, the one having the proper frequency as indicated by a wavemeter is the correct one. All 4 repeller tracking pots and R311 KLYSTRON BIAS pot should be used to improve pulse shape as shown in Figure 4-7 and described above.
CAUTION: Do not adjust pots to produce more than 2.3 volts across test points TP401 and TP402.
If proper pulsing is still not obtained, loosen the klystron retainer nut and slightly rotate the klystron in the cavity using care not to exert side pressure on the tube. If the generator can not be made to supply a clean pulse over the entire frequency range, it may be necessary to replace the klystron tube.

4.5.6 RF Power Output - Turn the MODULATION SELECTOR switch to CW and allow the signal generator to stabilize for at least ½ hour. Consult Sections 2.2 and 2.3 for CW operation. Rotate the ATTENUATOR and ZERO SET controls and note which of the shafts passing through the modulator chassis turns for each function. Connect a power measuring instrument to the RF OUTPUT connector.

CAUTION: Never allow attenuator or power monitor controls to "slam" into stops or probe damage may result.

Never allow the probes to drop into the attenuator tubes as this may damage the probes or break the klystron.

In order to adjust the probes the fan must be removed. Remove the two #6 screws holding the fan bracket to the modulator chassis and the two #6 flathead screws and nuts holding it to the back-plate.

The signal generator may be operated without the fan providing that the ambient temperature never exceeds 35°C and the MODULATION SELECTOR is kept in the OFF or PULSE position at least 60% of the operating time.

(a) Every 400 mc throughout the range of the signal generator follow the procedure for obtaining -7DBM of CW output checking the accuracy of output and the position of the power set cursor. At the extremes of motion of the POWER SET and ATTENUATOR knobs check to see that the guide pins on the probe collars do not rest against the ends of the guide slots. If the specified accuracy is met, the cursor does not hit its mechanical stops and the guide pins do not touch the ends of their slots no recalibration is needed. If recalibration is necessary remove the fan and proceed with steps (b) through (e).

(b) If guide pins do not hit the ends of the slot proceed with steps (c). If they do, hold the pin and loosen the rear flexible coupling on the drive shaft side. Turn the appropriate control knob to its extreme clockwise position. Move the pin up approximately 1/16-inch from the bottom of the slot and tighten the coupling set screws.

(c) Scan the full frequency range of the generator, resetting the POWER SET control so that the needle on the meter is always on the Power Set mark. Note the extremes of motion of the cursor window. Tune the generator to a frequency where the cursor window is midway between the extremes. Turn the POWER SET control so that the cursor is centered in the window and disregard the meter reading. Holding the power probe or its cable, loosen the clamping screw on the probe collar. While holding the collar to prevent its movement, change the insertion of the probe in the attenuator tube to cause the meter needle to fall on the Power Set mark, simultaneously rotating the probe for maxium indication. Tighten the collar clamping screw.

(d) At any convenient frequency reset the ZERO SET and POWER SET controls for -7DBM CW output as described in Sections 2.2 and 2.3. If the external power measuring instrument reads between -5DBM and -9DBM proceed with step (e). If the output does not fall within these limits hold the attenuator probe or its cable and loosen the clamping screw on the probe collar. While holding the collar to prevent its movement, change the insertion of the probe in the attenuator tube to obtain -7DBM indication on the power measuring instrument, simultaneously rotating the probe for maximum output.

(e) At 200 mc intervals throughout the range, set the signal generator for -7DBM CW output. Plot the deviation of indicated output from that level versus frequency (see Figure 4-6). Draw a straight line through the curve at the deviation which is the median of the two extremes. At some frequencies the curves will cross. Crank the KILO-MEGACYCLES dial to one of these frequencies and repeat step (d). The attenuator should now be calibrated to the specified accuracy.

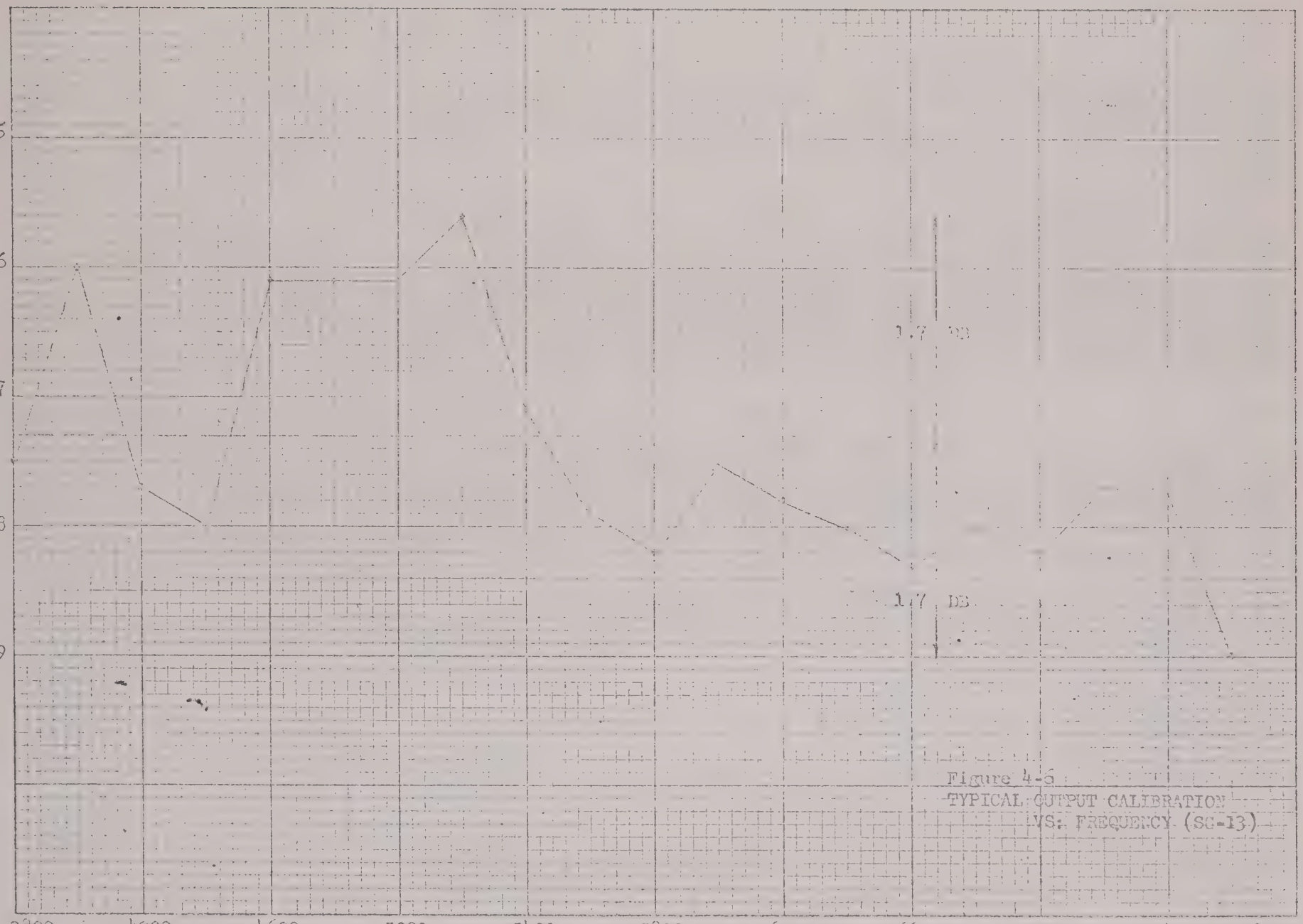


Figure 4-6
TYPICAL OUTPUT CALIBRATION
VS. FREQUENCY (SG-13)

	Frequency (MC)	Approx. Repeller Voltage
SG-13	3800	65
	5200	160
	7600	450
SG-14	7000	140
	9100	345
	9300	205
	11000	315

NOTE: Repeller voltage is measured between TB?01 terminal 6 and terminal 2 of the tracking pot.

SCOPE DISPLAY OF DETECTED RF PULSE
(Internal Pulse Modulation, 10 μsec Width, 2 μsec Delay)

Correct Operation

Off-Mode Operation

Figure 4-7
REPELLER VOLTAGE ADJUSTMENT

4.6 TRACKING POT REPLACEMENT

If replacement of the tracking pot is necessary, remove the wires and code them. Remove the two screws holding the cover and remove the cover. Holding the potentiometer in place by hand, crank the KILOMEGACYCLES dial to the low frequency stop, noting the direction of rotation of the pot's wiper. Remove the assembly and disassembly by removing the cap screw on the wiper block. Reassemble all removed parts to the replacement pot in the reverse order. Position the wiper at the low frequency end of the resistance track as previously noted. Replace the pot with the terminals positioned as before, rotating the body slightly if necessary to enable the worm gear to mesh. Replace the cover but do not tighten the clamping screws. Connect an ohmmeter between the wiper terminal and the low frequency end terminal. Ascertain that the crank is still fully counterclockwise. Turn the body of the pot until the ohmmeter reads between 200 and 400 ohms and tighten the clamping screws. Replace the wires and retrack as detailed in Section (4.5.5).

SECTION V

PARTS LIST FOR
SIGNAL GENERATORS, MODELS SG-13 AND SG-14

I. CAPACITORS

Ref. Symbol	Description	Part of
C101A, B	Capacitor, paper; 2 X .25 MFD, 600 V	Pwr. Supply
C102	" electrolytic; 70 MFD, 400 V	"
C103	" electrolytic; 70 MFD, 400 V	"
C104	" ceramic disc; .05 MFD, 600 V	"
C105A, B	" electrolytic; 2 X 35 MFD, 400 V	"
C106	" ceramic disc; .05 MFD, 500 V	"
C107	" paper; .1 MFD, 400 V	"
C108	" electrolytic; 70 MFD, 400 V	"
C109	" electrolytic; 70 MFD, 400 V	"
C110	" ceramic disc; .05 MFD, 500 V	"
C111	" ceramic disc; .05 MFD, 500 V	"
C201	" disc; .05 MFD, 500 V	Modulator
C202	" disc; .05 MFD, 500 V	"
C203	" ceramic disc; .01 MFD, 500 V	"
C204	" ceramic disc; .005 MFD, 500 V	"
C205	" mica; 100 pf 10% 500 V	"
C206	" electrolytic; 12 MFD, 450 V	"
C207	" oil filled; 1 MFD, 600 V	"
C208	" mica; .015 MFD, 2%, 500 V	"
C209	" mica; 1500 pf 2%, 500 V	"
C210	" mica; 150 pf 2%, 500 V	"
C211	" ceramic disc; .05 MFD, 500 V	"
C212	" ceramic disc; .05 MFD, 500 V	"
C213	" mica; 1500 pf 2%, 500 V	"
C214	" mica; .015 MFD, 2%, 500 V	"
C215	" mica; 150 pf 2%, 500 V	"
C218	" ceramic disc; .05 MFD, 500 V	"
C219	" oil filled; 2 MFD, 600 V	"
C220	" oil filled; .5 MFD, 600 V	"
C221	" paper; .1 MFD, 10%, 400 V	"
C222	" paper; .01 MFD, 10%, 400 V	"
C223	" mica; 820 pf, 10%, 500 V	"
C224	" mica; 500 pf, 10%, 500 V	"
C225	" ceramic disc; .01 MFD, 500 V	"
C226	" mica; 100 pf, 10%, 500 V	"
C227	" ceramic disc; .01 MFD, 500 V	"
C228	" oil filled; .25 MFD, 600 V	"
C229	" mica; 500 pf 10%, 500 V	"
C230	" mica; 33 pf 10%, 500 V	"
C231	" mica; 510 pf, 2%, 500 V	"
C232	" mica; 5600 pf, 2%, 500 V	"
C233	" ceramic disc; .05 MFD, 500 V	"
C234	" mica; 33 pf, 10%, 500 V	"

I. CAPACITORS (continued)

Ref. Symbol	Description	Part of
C235	Capacitor, ceramic disc; .01 MFD, 500 V	Modulator
C236	" mica, 100 pf, 10%, 500 V	"
C237	" ceramic disc; .01 MFD, 500 V	"
C238	" mica; 100 pf, 10%, 500 V	"
C239	" ceramic disc; .01 MFD, 500 V	"
C240	" paper; .01 MFD, 10%, 400 V	"
C241	" ceramic disc; .01 MFD, 500 V	"
C243	" ceramic disc; .01 MFD, 1600 V	"
C244	" paper; .1 MFD, 1600 V	"
C246	" ceramic disc; .05 MFD, 500 V	"
C247	" oil filled, 1 MFD, 600 V	"
C248	" oil filled, .5 MFD, 1500 V	"
C249	" mica, 56 pf, 10%, 500 V	"
C402	" oil filled, 4 MFD, 1500 V	Pwr. Supply
C403	" ceramic disc; .05 MFD, 1000 V	"
C404	" electrolytic; 2x35 MFD, 350 V	"
C405	" electrolytic; 5 MFD, 50 V	"
C406	" oil filled, 1 MFD, 1500 V	"

II. CRYSTALS (DIODES)

Ref. Symbol		Description	Part of
CR101	A-40	1 KV PIV silicon rect.	Pwr. Supply
CR102	A-40	" " " "	"
CR103	A-40	" " " "	"
CR104	A-40	" " " "	"
CR105	SD-95	500 V PIV silicon rect.	"
CR106	A-40	1 KV PIV silicon rect.	"
CR107	A-40	" " " "	"
CR108	A-40	" " " "	"
CR109	A-40	" " " "	"
CR201	1N459		Modulator
CR202	1N459		"
CR203	1N2358	1500 V PIV silicon rect.	"
CR204	1N459		"
CR205	1N459		"
CR206	1N488A		"
CR401	A-40	1000 V PIV silicon rect.	Pwr. Supply
CR402	A-40	" " " "	"
CR403	A-40	" " " "	"
CR404	A-40	" " " "	"
CR405	A-40	" " " "	"
CR406	A-40	" " " "	"
CR407	A-40	" " " "	"
CR408	A-40	" " " "	"
CR409	SD-95	500 V PIV silicon rect.	"
CR410	1N1786	Zener diode	"
CR411	SD-95	500 V PIV silicon rect.	"
CR412	"	" " " "	"
CR413	"	" " " "	"

III. DIAL LIGHTS

Ref. Symbol	Description	Part of
DS101	#47 lamp	Pwr. Supply

IV. FANNING STRIP

Ref. Symbol	Description	Part of
E101	8 terminal angle fanning strip	Pwr. Supply

V. FUSES

Ref. Symbol	Description	Part of
F101	3 amp, Slo-Blo* 3 AG	Pwr. Supply
F102	.5 amp, Slo-Blo	"
F103	.5 amp, Slo-Blo	"
F401	.5 amp, Slo-Blo	"

* 1 1/2 amp Slo-Blo for 230 V use only (not supplied)

VI. CONNECTORS

Ref. Symbol	Description	Part of
J201	UG-909A/U	Modulator
J202	UG-625/U	"
J203	UG-625/U	"
J204	UG-625/U	"
J205	UG-909A/U	"
J206	UG-909A/U	"
J207	UG-909A/U	"
J208	Type "N" special	"
P101	6'-3 wire cord set	Pwr. Supply
P101A	3 wire-2 wire adapter	"
P201	UG-88/U	Modulator
P202	UG-88/U	"
P203	UG-88/U	"

VII. INDUCTORS

Ref. Symbol	Description	Part of
L201	plate coil; 390 uh	Modulator
L202	plate coil; 100 uh	"

VIII. METERS

Ref. Symbol	Description	Part of
M201	meter, 0-200 ua; 360 ohms; dwg. no. B21971	Modulator

IX. RESISTORS

Ref. Symbol	Description	Part of
R101	Resistor, composition; 150 K ohms, ± 10%, 2W	Pwr. Supply
R102	" " 150 K ohms, ± 10%, 2W	"
R103	" " 680 K ohms, ± 10%, 1W	"
R104	" " 680 K ohms, ± 10%, 1W	"
R105	" " 1.2 K ohms, ± 10%, 1/2W	"
R106	" " 1.2 K ohms, ± 10%, 1/2W	"
R107	" " 22 ohms, ± 10%, 1/2W	"
R108	" " 22 ohms, ± 10%, 1/2W	"
R109	" " 470 K ohms, ± 10%, 1W	"
R110	" " 33 K ohms, ± 10%, 2W	"
R111	" " 33 K ohms, ± 10%	"
R112	" " 33 K ohms, ± 10%, 2W	"
R113	" " 33 K ohms, ± 10%, 2W	"
R114	" " 470 K ohms, ± 10%, 1/2W	
R115	Potentiometer; 10 K ohms, 2W, linear taper	
R116	Resistor, composition; 18 K ohms, ± 10%, 1W	
R117	" " 47 K ohms, ± 10%, 2W	"
R118	" " 470 ohms, ± 10%; 1W	"
R120	" " 10 K ohms, ± 10%, 1W	"
R121	" " 2.2 K ohms, ± 10%, 1/2W	"
R122	" " 220 K ohms, ± 10%, 2W	"
R123	" " 220 K ohms, ± 10%, 2W	"
R124	" " 1.2 K ohms, ± 10%, 1/2W	"
R125	" " 470 K ohms, ± 10%, 1/2W	"
R126	" " 47 K ohms, ± 10%,1W	"
R127	" " 220 K ohms, ± 10%, 1/2W	"
R128	" " 27 K ohms, ± 10%, 1/2W	"
R129	" " 470 K ohms, ± 10%, 1/2W	"
R130	" wire wound; 20 K ohms, ± 10%, 20W	"
R131	" composition; 150 K ohms, ± 5%, 1W	"
R132	Potentiometer; 50 K ohms, 2W linear taper	"
R133	Resistor, composition; 390 K ohms, ± 5%, 1W	"
R201	" " 1 megohm, ± 10%, 1/2W	Modulator
R202	" " 1 megohm, ± 10%, 1/2W	"
R203	" " 100 ohms, ± 10%, 1/2W	"
R204	" " 47 K ohms, ± 10%, 2W	"
R119	" wire wound; 4 K ohms, ± 10%, 10W	Pwr. Supply

IX. RESISTORS continued

Ref. Symbol	Description	Part of
R205	Resistor, composition; 4.7 megohms, ± 10%, 1/2W	Modulator
R206	" " 47 K ohms, ± 10%, 2W	"
R207	" " 15 K ohms, ± 10%, 1/2W	"
R208	" " 10 K ohms, ± 10%, 2W	"
R209	" " 100 K ohms, ± 5%, 1/2W	"
R210	" " 100 K ohms, ± 5%, 1/2W	"
R211	" " 430 K ohms, ± 5%, 1/2W	"
R212	Potentiometer; 5 M ohms, 5 M ohms, 2.5 M ohms	"
R213	Resistor, composition; 10 K ohms, ± 10%, 2W	"
R214	" wire wound; 20 K ohms, ± 10%, 10W	"
R215	" " " 22.5 K ohms, ± 10%, 10W	"
R216	" composition; 100 ohms, ± 10%, 1/2W	"
R217	" " 100 ohms, ± 10%, 1/2 W	"
R218	" " 4.7 megohms, ± 10%, 1/2W	"
R219	" " 100 K ohms, ± 10%, 1/2W	"
R221	" " 100 K ohms, ± 10%, 1/2W	"
R222	" " 430 K ohms, 5%, 1/2W	"
R223	" " 470 K ohms, ± 10%, 1/2W	"
R225	" " 47 K ohms, ± 10%, 2W	"
R226	" " 100 ohms, ± 10%, 1/2W	"
R227	" " 150 K ohms, ± 10%, 1/2W	"
R228	" " 15 K ohms, ± 10%, 1/2W	"
R229	" " 100 ohms, ± 10%, 1/2W	"
R230	" " 22K ohms, ± 10%, 1/2W	"
R231	" " 150 K ohms, ± 10%, 1/2W	"
R232	" " 2.7 K ohms, ± 10%, 1/2W	"
R233	" " 3.3 K ohms, ± 10%, 1/2W	"
R234	" " 10 K ohms, ± 10%, 2W	"
R235	Potentiometer; 25 K ohms, 2W, linear taper	"
R236	" 25 K ohms, 2W, linear taper	"
R237	" 10 K ohms, 2W, linear taper	"
R238	Resistor, composition; 47 K ohms, ± 10%, 2W	"
R239	" " 100 ohms, ± 10%, 1/2W	"
R240	" " 1 megohm, ± 10%, 1/2W	"
R241	" " 470 K ohms, ± 10%, 1W	"
R242	" " 150 K ohms, ± 10%, 2W	"
R243	" " 150 K ohms, ± 10%, 2W	"
R244	" " 47 K ohms, ± 10%, 2W	"
R245	" " 47 K ohms, ± 10%, 2W	"
R246	" " 2.2 K ohms, ± 10%, 1/2W	"
R247	" " 3.3 K ohms, ± 10%, 1/2W	"
R248	" " 1.2 K ohms, ± 10%, 1/2W	"
R249	" " 150 K ohms, ± 10%, 1/2W	"
R250	" " 15 K ohms, ± 10%, 1/2W	"
R251	" " 100 ohms, ± 10%, 1/2W	"
R252	" " 100 ohms, ± 10%, 1/2W	"

IX. RESISTORS continued

Ref. Symbol	Description	Part of
R253	Resistor, composition; 22 K ohms, ± 10%, ½W	Modulator
R254	" " 150 K ohms, ± 10%, ½W	"
R255	" " 2.7 K ohms, ± 10%, ½W	"
R256	" " 3.3 K ohms, ± 10%, ½W	"
R257	" " 1 K ohms, ± 10%, ½W	"
R258	" " 470 ohms, ± 10%, ½W	"
R259	" " 470 ohms, ± 10%, ½W	"
R261	" " 1 megohm, ± 10%, ½W	"
R262	" wire wound; 25 K ohms, ± 10%, 5W	"
R263	" composition; 100 K ohms, ± 10% ½W	"
R264	Potentiometer; 25 K ohms, 2W, log taper	"
R265	" 2.5 K ohms, 2W, linear taper	"
R266	Resistor, composition; 47 K ohms, ± 10%, ½W	"
R267	" " 100 K ohms, ± 10%, ½W	"
R268	" " 1K ohms, ± 10%, ½W	"
R269	" " 1.2 K ohms, ± 10%, ½W	"
R270	" " 100 ohms, ± 10%, ½W	"
R271	" " 1 megohm, ± 10%, ½W	"
R272	" " 220 ohms, ± 10%, ½W	"
R273	" " 2.2 K ohms, ± 10%, 2W	"
R274	" " 1 megohm, ± 10%, ½W	"
R275	" " 100 ohms, ± 10%, ½W	"
R276	" " 2.2 K ohms, ± 10%, 2W	"
R277	" " 10 K ohms, ± 10%, ½W	"
R278	" " 2.2 megohms, ± 10%, 1W	"
R279	Potentiometer; 2.5 K ohms, 5W, wire wound	"
R280	" 250 ohms, 2W, linear taper	"
R281	Resistor, wire wound; 3.5 K ohms, ± 10%, 20W	"
R282	" " " 3.5 K ohms, ± 10%, 20W	"
R283	Resistor, composition; 1M ohms, ± 10%, ½W	"
R284	" " 100 ohms, ± 10%, ½W	"
R285	" " 100 ohms, ± 10%, ½W	"
R287	" " 2.2 K ohms, ± 10%, 2W	"
R288	" " 1.5 K ohms, ± 10%, 2W	"
R291	" 250 K ohms, 2W, linear taper	"
R292	Resistor, composition; 180 ohms, ± 10%, ½W	"
R294	" " 220 ohms, ± 1%, ½W	"
R295	" " 220 ohms, ± 1%, ½W	"
R296	Resistor, composition; 47 ohms, ± 10%, ½W	"
R297	" " 120 ohms, ± 10%, ½W	"
R298	" " 220 ohms, ± 1%, ½W	"

IX. RESISTORS (continued)

Ref. Symbol	Description	Part of
R299*	Resistor, composition; 47 K ohms, ± 10%, 2W	Modulator
R300*	Potentiometer; 50 K ohms, 2W, linear taper	"
R301*	" 100 K ohms, 4W, special 55 K tap	"
R302*	Resistor, composition; 220 K ohms, ± 10%, 1/2W	"
R303*	Potentiometer; 50 K ohms, 2W, linear taper	"
R304*	Resistor, composition; 15 K ohms, ± 10%, 2W	"
R305*	" " 39 K ohms, ± 10%, 2W	"
R306*	Potentiometer; 100 K ohms, 2W, linear taper	"
R307*	" 100 K ohms, 2W, linear taper	"
R308*	Resistor, composition; 15 K ohms, ± 10%, 2W	"

* Used in Model SG-14 only
** Values shown below for Model SG-13 only

Ref. Symbol	Description	Part of
R299**	Potentiometer; 50 K, 2W, linear	Modulator
R300**	" 50 K, 2W, linear	"
R301**	" 100K, 4W, special 12.5K tap	"
R302**	Resistor, composition; 220 K, ± 10%, 1/2W	"
R303**	Potentiometer; 10 K, 2W, linear	"
R304**	Resistor, composition; 10K ± 10%, 1W	"
R305**	"; 10 K ± 5%, 2W	"

Ref. Symbol	Description	Part of
R311	Potentiometer; 5 K, 2W, linear taper	Modulator
R312**	" 5 K, 2W, linear taper	"
R313	Resistor, composition; 3.3K ohms ± 10%, 1W	"
R314	" " 430K ohms, ± 5%, 1/2W	"
R315	" " 390K ohms, ± 5%, 1/2W	"
R316	" " 470K ohms, ± 10%, 1/2W	"
R317	" " 10 K ohms, ± 10%, 1/2W	"
R318	" " 4.7K ohms, ± 10%, 2W	"

X. THERMISTORS

Ref. Symbol	Description	Part of
RT201	Thermistor, disc; special	Modulator
RT202	" , disc; special	"
RT203	" , dual bead assy, special	"

XI. SWITCHES

Ref. Symbol	Description	Part of
S101	Switch, toggle; DPST ST52K	Pwr. Supply
S201	Switch, wafer; 4 deck 6 pos. AS21856	Modulator
S202	Switch, wafer; 4 deck 6 pos.	"
S203	Switch, wafer; 1 deck 3 pos. B-2870	"
S204	Microswitch; SPDT-roller leaf	"

XII. TRANSFORMERS

Ref. Symbol	Description	Part of
T101	Transformer, power, [illegible]	Pwr. Supply
T201	Transformer, blocking oscillator B-22017	Modulator
T202	Transformer, blocking oscillator B-22017	"
T401	Transformer, beam supply B-21803	Pwr. Supply

XIII. TERMINAL BOARDS

Ref. Symbol	Description	Part of
TB201	Barrier strip, 8 terminal	Modulator

XIV. TEST JACKS

Ref. Symbol	Description	Part of
TP401	Tip jack	Pwr. Supply
TP402	Tip jack	"

XV. TUBES

Ref. Symbol	Description	Part of
V101	6080	Pwr. Supply
V102	6AU6	"
V103	OB2	"
V104	6AQ5	"
V105	12AX7	"
V106	OA2	"
V201	12AT7	Modulator
V202	12AU7	"
V203	12AT7	"
V204	12AT7	"
V205	12AT7	"
V206	6AS6	"
V207	12AT7	"
V208	12AU7	"
V209	12AT7	"
V210	12BY7	"
V211	6236 klystron SG-13 only	"
V211	6390 klystron SG-14 only	"
V212	OA2	"
V401	7591	Pwr. Supply
V402	12AX7	"

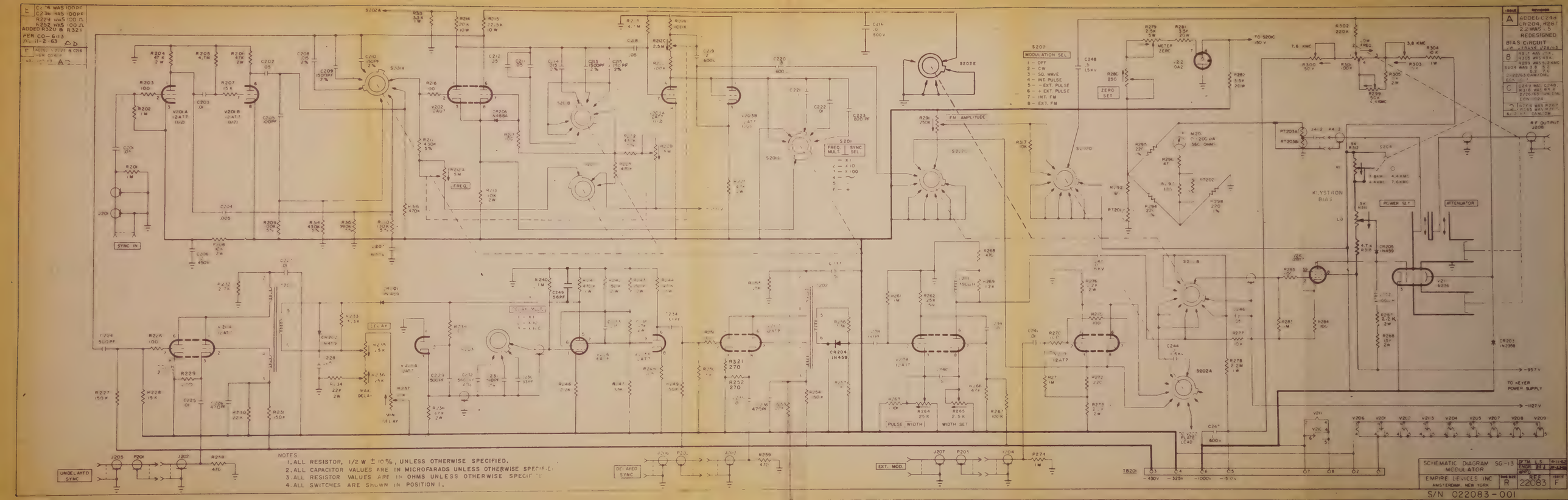
REVISIONS			
SYMBOL	DESCRIPTION	DATE	APPROVED
A	[illegible]	[illegible]	[illegible]
B	[illegible]	[illegible]	[illegible]
C	[illegible]	[illegible]	[illegible]
D	ADDED CR411-412-413	7/16/62	CAM/DEA
E	ECN-1018	2/22/63	CAM/DM

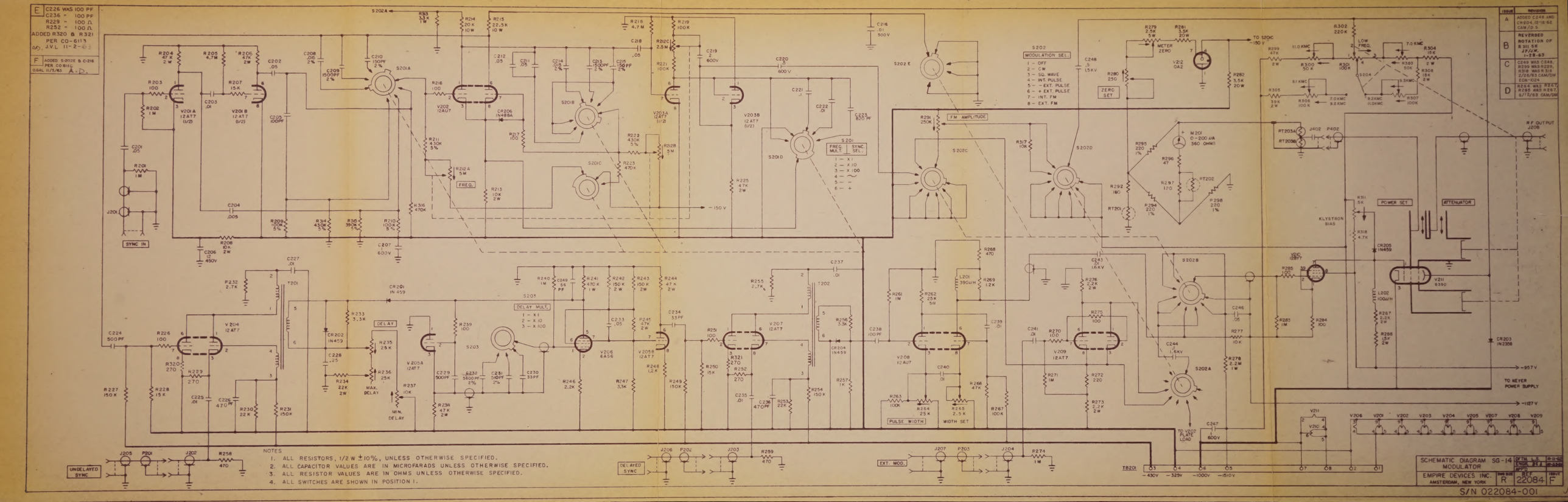
INPUT:
115 VOLTS ±10%
50 TO 65 CPS
1 PHASE

ALTERNATE CONNECTION
FOR 230 VAC ±10%
USE 1½ A FUSE (F101)

NOTES:
1. ALL RESISTORS ARE 1/2 W, ±10% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFED.

C. MORCK	7-25-62	SCHEMATIC DIAGRAM POWER SUPPLY SG13 - SG14	EMPIRE DEVICES INC. Amsterdam, New York
E.J. KALENIK	7-25-62		R 22082 E


NOTES:
1. ALL RESISTOR, 1/2 W ± 10%, UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
4. ALL SWITCHES ARE SHOWN IN POSITION 1.
SCHEMATIC DIAGRAM SG-13 MODULATOR
EMPIRE DEVICES INC AMSTERDAM, NEW YORK
S/N 022083-001


E C226 WAS 100 PF C236 " 100 PF R229 " 100 Ω R252 " 100 Ω ADDED R320 & R321 PER CO-6111 J.V.L. 11-2-62
F ADDED S-202E & C-216 PER CO-6116 A.D. 11/5/63
S202A
S202E
S202C
S202D
S201
S201A
S201B
S201C
S201D
S202 MODULATION SEL.
1 - OFF
2 - CW
3 - SQ. WAVE
4 - INT. PULSE
5 - - EXT. PULSE
6 - + EXT. PULSE
7 - INT. FM
8 - EXT. FM
FM AMPLITUDE
FREQ.
FREQ. MULT. | SYNC. SEL.
1 — X1
2 — X10
3 — X100
4 — ~
5 — -
6 — +
DELAY MULT.
1 - X1
2 - X10
3 - X100
DELAY
MAX. DELAY
MIN. DELAY
PULSE WIDTH
WIDTH SET
METER ZERO
ZERO SET
LOW FREQ.
KLYSTRON BIAS
POWER SET
ATTENUATOR
SYNC IN
UNDELAYED SYNC
DELAYED SYNC
EXT. MOD.
RF OUTPUT J208
TO KEYER POWER SUPPLY
TO V202 PLATE LOAD
-957 V
-1127 V
-150 V
M201 0-200 μA 360 OHMS
V201A 12AT7 (1/2)
V201B 12AT7 (1/2)
V202 12AU7
V203A 12AT7 (1/2)
V203B 12AT7 (1/2)
V204 12AT7
V205A 12AT7
V205B 12AT7
V206 6AS6
V207 12AT7
V208 12AU7
V209 12AT7
V211 6390
V212 0A2
NOTES
1. ALL RESISTORS, 1/2W ±10%, UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
4. ALL SWITCHES ARE SHOWN IN POSITION 1.
ISSUE REVISIONS
A ADDED C248 AND CR204, 12-18-62 CAM/D.S.
B REVERSED ROTATION OF R311 5K J.F./J.W. 1-28-63
C C249 WAS C248, R239 WAS R229, R318 WAS R316 2/26/63 CAM/DM ECN-1024
D R264 WAS R267, R265 WAS R267, 6/17/63 CAM/DM
SCHEMATIC DIAGRAM SG-14 MODULATOR
EMPIRE DEVICES INC. AMSTERDAM, NEW YORK
SIZE R DWG NO. 22084 ISSUE F
S/N 022084-001

MP MASTER
MA36050